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RISK MANAGEMENT FOR AIR AMBULANCE HELICOPTER OPERATORS

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16. Abstract

This manual is intended to provide an easy reference for dealing with the operating pitfalls, the human frailties, and the risks in managing an air ambulance operation. It is not designed to give the operator step-by-step instructions. Rather, the manual describes techniques and tools that can be used to balance the demands of running a business with the need for maintaining safety. It provides pilot selection and training guidelines, as well as a review of a risk assessment technique that have proven successful for Part 135 operators. In addition, the manual recommends a workable format for establishing standard operating procedures to reduce risks. Finally, it highlights the key concerns that should be carefully considered from a risk management viewpoint.

This operators manual is one of an integrated set of five Aeronautical Decision Making (ADM) manuals developed by the Federal Aviation Administration in a concerted effort to reduce the number of human factor related helicopter accidents. It can be used as one element of a comprehensive program for improving safety, reducing risk and, hopefully, the high cost of helicopter hull and liability insurance. The other four documents of the set are:

1. ADM for Helicopter Pilots (DOT/FAA/PM-86/45)
2. ADM for EMS Helicopter Pilots -- Learning from Past Mistakes (DOT/FAA/DS-88/5)
3. ADM for EMS Helicopter Pilots -- Situational Awareness Exercises (DOT/FAA/DS-88/6)
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PREFACE

Everyone involved with the space shuttle Challenger loss over Florida on January 28, 1986, carries its memory. But one person, the NASA manager who gave final approval for the Challenger launch, must feel a particularly strong sense of grief and responsibility. Caught between the pressure to satisfy politicians, the American people, and NASA's launch schedule and a complicated array of possible system failures, he/she made a decision that proved wrong - fatally wrong.

On a more routine (but no less potentially lethal) basis, most air ambulance managers are caught between the pressure to run an efficient, lean, and responsive operation and the ever-present possibility that an overlooked or underestimated critical part, like that O-ring on the booster rocket, will fail. In the air ambulance business, the human element is the weak link, or critical part, that can fail more often than not. As that NASA manager knows only too well, no matter who the pilot-in-command is, the manager who selects that pilot, sets crew standards, duty cycles, establishes company weather minimums and other operating standards is ultimately responsible for mission safety.

TABLE OF CONTENTS Page

LIST OF FIGURES

Page

LIST OF TABLES

RISK MANAGEMENT
FOR
AIR AMBULANCE OPERATORS

1.0 INTRODUCTION

The objective of this helicopter air ambulance operator risk management manual is to provide a systems approach to risk assessment and risk management for use by operators and administrators.

The National Transportation Safety Board (NTSB) published the results of an intensive review of "Commercial Emergency Medical Service Helicopter Operations" on January 28, 1988, (NTSB/SS-88/01). One of the 26 primary conclusions was that: "Hospital EMS program management can have significant impact on the program's safety. Effective communication between the helicopter operator management and the hospital EMS program management is essential to safe EMS helicopter operations." Both helicopter operator and hospital administrator program management can dramatically impact the helicopter pilot's motivation, decision making, and risk assessment capabilities. Program management and operational philosophy impact how risks are assessed and managed at all levels of an EMS program.

1.1 THE HELICOPTER'S LIFE SAVING HISTORY

The impact of the helicopter in the air ambulance role can best be illustrated by a brief review of its military origins. In World War II, injured soldiers waited about eight hours, on the average, before treatment. The death rate was 10 percent (Brown). In Korea, the wait was reduced to 3 hours. The death rate fell to 2.5 percent through the use of helicopter air evacuation in conjunction with improved trauma treatment, better medical training, etc. In Vietnam, 90 percent of the casualties were transported by helicopter, the wait was reduced to one to two hours, a system of field hospitals, better medicines, and the death rate fell to below one percent (Stein).

This military experience has not failed to produce a significant impact on the minds of the American public. In 1986, commercial air ambulance operators performed about 95,000 transports and public service helicopters about 15,000 (Collett). Several medical studies have attempted to quantify the impact of these transports on mortality rates. While the results have been mixed, it is a fact that mortality rates have been significantly reduced. The difficulty in quantifying arises from the relatively small numbers obtainable in a homogeneous data base (i.e., the number of compatible victims in the same age group, of the same sex, with the same injuries, etc. being transported by air ambulance vs. ground ambulance). The reduction in mortality rate estimates range from 21 percent to 52 percent in these studies. Applying these percentages to the total of 110,000 civil air ambulance transports in 1986 translates into between 22,000 and 55,000 lives saved in the United States in one year.

1.2 HELICOPTER AIR AMBULANCE ACCIDENT HISTORY

Historically speaking, a very high percentage of helicopter accidents are related to "pilot error." In a 1986 study of 10 years (1974-1984) of helicopter accidents, it was found that 64 percent of all civil helicopter accidents were assigned pilot error as a cause or factor (Adams,

1986). This data covered a full spectrum of helicopter operations such as: Corporate, Instruction, Construction, Air Ambulance, etc. Detractors have some justification in their claim that: "...pilot error is just a catch-all category that is conveniently used when no other accident cause can be determined." However, it is equally true that pilots have not discovered or invented any new ways to make disastrous mistakes in the past 80 years. Consider the following facts:

- An aircraft runs out of fuel every other day in the United States (Aviation Safety).

- Inadvertent penetration of Instrument Meteorological Conditions (IMC) is the primary cause of all fatal accidents (NTSB)

- 62 percent of the helicopter pilots having accidents in IMC were not instrument rated (Adams,1986).

As workload, risks, and stress increase, such as in the more specialized Army nap-of-the-earth missions or the civil emergency medical service operations, the pilot error accident causal factor increases from the 64 percent average to the 90 percent mission specific level. However, the predominance of weather related accidents remains unchanged. The 1988 NTSB review of the past two years of EMS data (Reference 1) shows that:

- 86 percent of the accidents occurred en route
- 67 percent were weather related
- 48 percent occurred at night in marginal weather
- 19 percent occurred during daytime marginal weather

Clearly, the majority of these accidents involved flying with reference to instruments to some degree. Yet, relatively few helicopters are instrument certified and an instrument current helicopter pilot is an exception rather than the rule. The NTSB study found that 80 percent of the currently employed EMS helicopter pilots were instrument rated (no indication was given between pilots having helicopter, fixed-wing, or dual instrument ratings). However, only 28 percent of these pilots were reported as being instrument current. Similarly, of the pilots involved in the 15 reduced visibility accidents, all but two had instrument ratings. However, only one was current at the time of the accident.

1.3 PILOT EXPERIENCE AND QUALIFICATIONS

In contrast to the lack of instrument currency, helicopter pilots who have accidents are usually mature, professional, experienced individuals. In the most recent NTSB study, air ambulance pilots who have been involved in reduced visibility accidents have a median experience level of 5,500 hours. A previous "Review of Rotorcraft Accidents 1977-1979" (NTSB-AAS-81-1) analyzed 892 accidents occurring during the referenced time period. Nearly three-fourths (74 percent) of the pilots were commercially rated, the average age was 37, they had 100-500 hours in type and about 50 flight hours in the last 90 days.

The facts related in the preceding pages lead to two unsettling questions. What types of mistakes are these experienced pilots making? Why are mature, professional pilots making so many catastrophic blunders in the EMS industry? Answers to these questions, as well as a structured approach to risk management will be presented in the remainder of this manual.

2.0 OPERATIONAL PITFALLS

The types of mistakes being made are reflected in the data summarized in the 1986 FAA study. The pilot error, or human factors, accidents in this data base (1974-1984) were mostly (83 percent) the result of two types of errors. Operational errors accounted for 42.2 percent. Decision or judgment accounted for 40.8 percent. Closer examination of the operational or technique error category showed that it contained some very familiar decision and judgment errors.

Ninety-two percent of the accidents in this category were caused by:

1. Failure to maintain rotor rpm or flying speed (engine failure, failed autorotations, fuel exhaustion, fuel contamination).

2. Improper use of flight controls (procedures).

3. Failure to see and avoid obstacles (mission, workload, fatigue).

Fuel exhaustion, fuel contamination, workload, and fatigue accidents are directly the result of poor decision making under stress and inadequate risk management. Improper use of flight controls is a basic flying skill or proficiency problem. But, the question remains: What caused the pilot on this occasion to make this error, or series of errors, that resulted in an accident?

In the decision making and judgment error category, the correlation with basic human errors is more direct. The majority (55 percent) of these accidents were the result of:

1. Inadequate preflight preparation (poor preflight decision making).

2. Inadequate supervision of flight or diverted attention from flight (inadequate risk management).

3. Mismanagement of fuel (lack of situational awareness).

These six mistakes in the operational technique and decision making or judgment categories are the pitfalls or traps into which pilots typically fall. But, what are the underlying reasons why they fall into them?

2.1 PILOT CHARACTERISTICS

Pilot motivation factors are a very important part of the operational risk problem. More than any other helicopter mission, air ambulance operations are driven by economics. Contracts with hospitals are often re-bid on a one-or two-year cycle. Consequently, if the hospital is dissatisfied with the current operator from either a mission reliability or economic viewpoint or some emotional feeling that a neighboring hospital is getting more of the transport business, the contract may be in jeopardy. Consequently, pilots feel pressure (both actual and self imposed) to maintain high utilization rates, launch within the specified "maximum" time and successfully complete each humanitarian mission.

Submitting to these pressures results in the acceptance of weather minimums that many other helicopter pilots performing more benign missions would refuse to fly in. To compound the risk, many of these missions are remote site pick-ups which require landing at unprepared areas, among trees, wires, and sometimes on hillsides.

Finally, pilots by nature are goal-oriented individuals. This characteristic adds self-induced pressure to the pilot error equation. Pilots feel compelled to:

- Make a flight when requested
- Meet schedules
- Complete the flight as planned
- Make money
- Please people (supervisors, medical personnel, victim's family)
- Impress peers

These motivational factors combined with the slow speed, high maneuverability of the helicopter and a basic mind set that "we can always put it down somewhere" strongly contribute to the chain of poor decisions which can result in an accident. In essence, the pilot's ingrained attitude predispose him/her to making the decision to go even when his/her training, the facts, or standard operating procedures indicate it is not the safe decision.

In addition to the pitfall created by these pilot motivational factors (which can be changed), there are some basic personality factors which cannot be easily altered. In 1980, a study of pilot personality traits was performed in Canada. The goal of the tests was to develop candidate selection tools (Skjenna, 1981).

> *"Approximately 25 helicopter student pilots, 80 fixed-wing student pilots and 60 air traffic controllers were tested. Early in the testing, it became apparent that the helicopter pilots were different than the other pilots tested. Helicopter pilots tended to be low in conformity and productivity. They expressed a need to control others. This type of personality may be easily influenced. That is, they can succumb to pressures of the situation or be coerced into a potential accident situation. In addition, helicopter pilots scored very high in their need for achievement.*
>
> *With the exception of two, all of the pilots showed a pattern of wishing to be independent and away from the confines and restraints of air traffic control and other agencies. They all tended to be self-starters and all but three had been involved in setting up their own small businesses.*
>
> *All of the helicopter pilots scored well in the ability to self-evaluate. Their chosen careers matched their conformity and productivity inclinations. The one area in which all of the pilots were unrealistic was their judgment of their career potentials flying helicopters. They were extremely confident that they would be hired right after graduation and recoup their multi-thousand dollar training investment in a short time. During this time period, there was a glut of helicopter pilots on the market and some schools were achieving only about a 50 percent placement rate for their graduates. This tendency toward unrealistic optimism, when carried over to a potential accident situation, adds further motivation toward making the wrong decision in a stressful situation."*

2.2 RISKS DEFINED

In summary, what have we learned about the helicopter risk exposure in the air ambulance role? First, both military and civil experience has documented that the helicopter can play a significant and critical role in saving lives. Second, in support of this life saving role, the pilot is placed in a high risk, high stress environment much more demanding than the typical corporate transport, air taxi, or other commercial operation. Put in this high risk situation, the helicopter air

ambulance pilot succumbs to human error much more frequently than his or her peers in other applications (90 percent vs. 64 percent pilot error accidents).

Data has shown that the air ambulance accident pilots are mature, experienced professionals who are trying their best to be responsible and to cope with the situations in which they find themselves. However, we have also documented that due to their basic motivational, success oriented attitudes they often make the wrong decision. In addition, the basic optimism with which they approach all aspects of their lives becomes a risk factor over which they have little or no control, especially in a work overload situation.

What does all of this mean from a risk management standpoint? It means that we can only achieve limited success in reducing pilot error accident rates if the pilot is the only piece of the operational problem being fixed. In actuality, as stated by the NTSB, program management plays a critical role in the safety record of any operation. Also, it is not enough to just have a strong, responsible management which monitors and enforces a strict set of standard operation procedures. That management must also be sensitive to the psychological, physiological, and sociological needs of the pilots. The management must set up and follow through on a risk management program that includes everyone involved in the day-to-day successful operation of the program. This is referred to as the systems approach to risk management.

This systems approach has been recognized by the U.S. Army. Table 1, Human Error Class A Aircraft Accident Cause Factors, provides their assessment of the percentage of Class A helicopter accidents (defined as an accident involving total property damage and personnel injuries of $500,000 or more, destruction of an Army aircraft, and/or an injury or occupational illness resulting in a fatality or permanent total disability) attributable to individual vs. system generated errors (McGhee, et al, 1987).

Table 1. Human Error Class A Aircraft Accident Cause Factors
(U.S. Army, First Quarter 1987)

SELF-GENERATED ERRORS (52 percent)	SYSTEM-GENERATED ERRORS (48 percent)
- Inattention	- Inexperience
- Poor Attitude	- Lack of Supervision
- Overconfidence	- No Written Procedures
- Lack of Composure	- Poor Equipment Design

Finally, Table 2, Commercial EMS Helicopter Accident Risk Factors, shows the analogous set of system generated errors and pilot-generated errors from the 1988 NTSB report. As shown in the table, the pilot is responsible for many important factors such as the ultimate go/no-go decision for each mission and thorough knowledge of the weather risk factor. However, table 2 also provides the first insight into the significant role played by other elements of the air ambulance risk equation including the vendor, the hospital administration, the FAA, and the helicopter manufacturer.

Table 2. Commercial EMS Helicopter Accident Risk Factors

PILOT-GENERATED FACTORS	SYSTEM-GENERATED FACTORS
• Qualifications	• Qualifications
- Certificates	- Training
- Ratings	- Currency Requirements
- Experience	
• Abilities	• Responsibilities
• Judgment	• Judgment
- Go/No-Go	- Mission Influence
- Inadvertent IMC	- Program Competition
• Weather Information	• Weather Information
- Preflight Planning	- FAA Requirements
- Local Knowledge	- Availability/Granularity
- "Today" Minimums	- Company Minimums
• Fatigue	• Fatigue
- Outside Activities	- Duty Cycle
- Health	- Number of Pilots
- Nutrition	- Industry Standards
• Stress	• Program Management
- Medication	- Standard Procedures
- Alcohol	- Supervision
- Personal/Family	- Visibility
	• Helicopter Reliability/Design
	• Helicopter Crashworthiness

3.0 RISK MANAGEMENT

In order to understand the risk management process, it is necessary to define safety. One accepted definition is:

The identification and control of risk, according to a set of preconceived parameters.

Risk control involves the placing of appropriate limits on the risk parameters in order to achieve the desired level of safety. The parameters selected and the limits vary with the type of operation. Powerline patrol, corporate transpc .. offshore oil, and EMS all have significantly different risk elements. It is the objective of the systems approach to analyze the varying requirements from both top-down and bottom-up perspectives, to define all the factors contributing to the accident risk and to develop a comprehensive program to eliminate or minimize the risk associated with each factoı.

One segment of the aviation community – the insurance industry – is quite adept at risk management. To make a profit, insurance underwriters learn to evaluate risks, to take reasonable ones and reject bad ones. This is not a bad premise upon which to base an air ambulance risk management program.

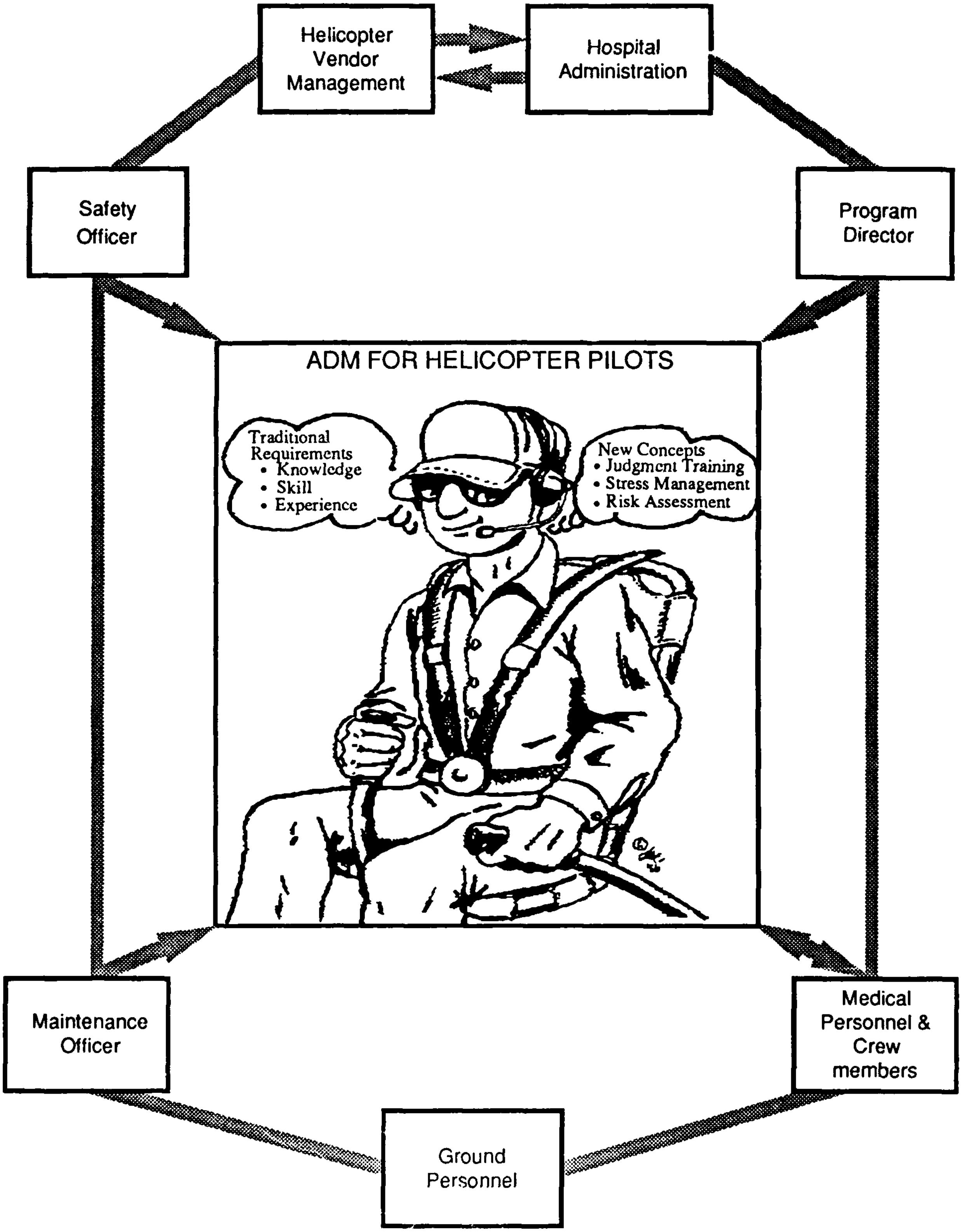
The responsibility for the identification and control of risks is spread throughout all levels of the hospital air ambulance system. The responsibility for support and compliance with a risk management program is primarily thast of the helicopter operator. However, it also relies on the support of the hospital administration to assure success.

The basic design philosophy of a risk management program is to develop a safety support system that encourages the making of safe decisions and that stands behind those who make those decisions afterwards. This type of management environment will reduce or eliminate the operational pitfalls which produce accidents and fatalities. The consistent application of this type of risk management system will contribute significantly toward the modification of pilot attitudes and motivational factors that eventually put everyone at risk.

Since the publication of the manual, ***Aeronautical Decision Making for Helicopter Pilots*** **(DOT/FAA/PM-86/45)**, there has been a significant groundswell of enthusiasm for the integration of these materials in many training programs. This is the first, important step in risk management – understanding the problem. However, we have seen in table 2, that the pilot does not have control over all of the risk factors. Figure 1, A Risk Management Support System, illustrates the type of risk management support system that is required to supplement the pilot's efforts to make safe decisions, handle stress, and reduce risks.

3.1 PROGRAM MANAGEMENT RESPONSIBILITIES

The foundation of EMS risk management is the helicopter program manager. Risk management starts with the formulation of a bid for each new air ambulance contract. At this time, management should review and assess the goals of the organization. A review of the safety and financial successes and failures of previous and current air ambulance organizations should be performed. Chief pilots or flight department managers should be called upon for their critiques and suggestions for improvements in the risk management program. The goal of this review is to develop a balanced orientation that considers the realities of service, revenue, profit, and safety equally.



gure 1. A Risk Management Support System

One way to achieve this goal is to analyze all direct and indirect costs associated with controlling the system-generated risk factors previously listed in table 2 along with the the other typical costs of operation. The decision must then be made whether to pass these costs along to the customer either in whole or in part.

Based upon accident statistics, and ongoing decision making research, it has been determined that there are at least two key elements of the helicopter operator risk management responsibility that should be included in any program.

The safe operator must:

(1) provide adequate budget to include safety awareness, initial training, and reinforcement training annually; and

(2) provide sufficient time to integrate training programs (flight currency and risk assessment) into the normal duty cycle.

Since both of these recommendations have significant cost implications, the time to begin risk management and safety improvement discussions with the hospital administration is prior to submitting a bid. The cost of risk management should be considered in relation to the cost of the helicopter, the average cost of an accident and the value of the lives of the patients and crew. These costs then represent a value several orders of magnitude over the relatively meager cost of the proposed additional training. On a more practical side, there are the costs associated with each piece of on-board medical equipment, autopilots, nomex flight suits and safety helmets. If the hospital treats these costs as necessary and practical, then the extra cost of improved risk management should be justifiable in the contract bid.

The prudent operator should also recognize that the training requirements extend beyond the pilots. Although medical personnel who fly in air ambulance helicopters are not considered crew members by the FAA, they often assume crew member functions, share safety of flight responsibilities, operate FAA approved equipment, etc. Therefore, they should be provided training as observers on approach, departure and en route; in making routine position report radio calls to dispatch; in the shutdown of aircraft power and fuel systems in the event of pilot incapacitation; and in making "mayday" calls in the event of an emergency.

Finally, the operator should provide training for non-flying personnel. It is often public safety and emergency response personnel who select the landing site, secure it from curious bystanders, brief the pilot on the site, etc. Their ability to manage these tasks is a serious responsibility requiring training and judgment. This training can be provided locally by the program personnel but management should participate in developing requirements and curricula. Topics to be covered should include, as a minimum, Landing Zone selection (size, wind direction, obstacles, marking for day and night operations, and approach/departure paths); night operations; assisting the crew; landing zone security; and helicopter ground safety.

3.2 HOSPITAL ADMINISTRATION RESPONSIBILITIES

The primary risk management responsibility of the hospital administration is to balance the patient risk factors with the ability and limitations of the helicopter to mitigate those risks. The hospital administrator must understand the limits to helicopter operation such as ceiling and visibility limits, fog, icing, etc. He or she must also be made aware of the operational pitfalls which have been costly in both lives and material losses in the past. The hospital administrator should be brought into the development process for standard operating procedures, scheduling, duty cycle constraints, weather minima and other risk control policy decisions. As with the

pilots, the first step in making the administrator a part of the solution is to be sure he/she understands the crux of the human error accident problem.

Based upon this understanding, the administrator is responsible for stressing hospital support of the risk management program and for its promulgation on a daily basis to the medical team. This support includes:

1. Positive reinforcement of compliance with safety directives and risk control decisions.

2. Familiarization with basic Federal Aviation Regulations (FAR's), Advisory Circulars (AC's), and published industry guidelines.

3. Cost support for currency training, safety, and risk management seminars.

4. Reevaluation of such self-imposed risks as the 5-minute minimum response time.

The last element in the risk management role of the hospital administrator is to provide tangible support for the program. This can vary from monthly bulletins addressing successes and failures to attendance at monthly or at least quarterly safety meetings conducted by the safety officer (an NTSB recommendation)

3.3 CHIEF PILOT OR FLIGHT MANAGER RESPONSIBILITIES

Progressing through the support system, the risk management tasks become more specific and more numerous. The first specific task that falls to the chief pilot is to develop and publish an operating philosophy approved by management. This operating philosophy should be based upon an understanding of:

1. The range of abilities and attitudes of the pilots.
2. A review of EMS accident reports, company accident and incident reports.
3. Coordinated administrative and operational risk management goals and procedures.
4. Duty cycle and scheduling constraints.
5. Currency training requirements.

To supplement the operating philosophy and maintain a sufficient awareness of the risk factors, a safety advisory committee should be established. This committee should include all members of the support system shown previously in figure 1. The chief pilot should be responsible for the follow through on the advisory committee recommendations with cooperation from the safety officer, pilots, medical air crew members, etc. as required.

It is the ultimate responsibility of the chief pilot to make the program work. This requires consistent demonstration of support for positive risk control decisions both on the ground and in the air. Reinforcement of positive attitudes is as important to continued operations as accepting and completing each and every mission. This reinforcement can be provided by creating the necessary work environment and by setting an example when faced with a marginally safe mission.

Finally, the chief pilot should be the one in the best position to monitor the risk management program to detect both positive and negative impacts. The responsibility for detecting these changes and reacting to them is an important step in understanding the problem.

3.4 PROGRAM DIRECTOR RESPONSIBILITIES

The program director responsibilities on the medical side are analogous to the chief pilot's on the helicopter side. That is, to make the program work, maintain an awareness of the importance of risk control and to monitor changing medical requirements. This responsibility requires a somewhat more complex information management and coordination workload than the chief pilot's. This is due to the fact that the program director has three masters (the hospital administrator, the chief pilot, and the aeromedical crew) while the chief pilot has only two.

The program director must act as the interface between the hospital administration and the risk management program. This responsibility includes:

1. Representing administration operating philosophy daily and at any safety meetings not attended by management.

2. Reports to the administration on successes, failures, and recommended changes to the risk management program.

3. Communication and coordination of medical and aviation safety concerns between the chief pilot and the air medical crews.

4. Support of any positive risk control decisions made by the pilot that may be in conflict with other hospital or air medical crew priorities.

The most important role of the program director is to ensure that agreed upon operational procedures, industry guidelines and accepted protocols are adhered to on a daily basis. Lapses should be called to the attention of the individuals involved immediately, documented, and presented (with specific individual anonymity) at the next safety meeting.

3.5 SAFETY OFFICER RESPONSIBILITIES

The safety officer is a vital link in the risk management, safety enhancement chain. It is his/her job to implement those policies and procedures the chief pilot, the program management and hospital administration have agreed upon. In this role, he/she has responsibility for both administration and operational implementation. He/she must create material for both the monthly safety advisory committee meetings and for safety bulletins or newsletters. He/she should also maintain and distribute any pertinent accident or incident reports and integrate this material into a risk awareness program as well as a reference library.

The safety officer also has the responsibility of communicating information up the chain of command. In this capacity, he/she should either have the capability of providing major inputs into, or managing the monthly safety meetings.

3.6 MAINTENANCE OFFICER RESPONSIBILITIES

The maintenance officer is in a position to observe, record, and report unsafe conditions or practices. He/she has the responsibility to assure the highest level of performance from the equipment, but also to report misuse or unsafe operation of the helicopter such as engine overtemps, rotor overspeeds, overlooked deficiencies during preflight, etc. He/she should be involved in developing a safety reporting form and the means of distributing the information. He/she should be required to attend all safety meetings and to read all safety reports.

The maintenance officer needs to be aware of the critical nature of his/her role to the overall risk management program. He/she should be an integral part of the development of standard operating procedures which are affected by, or have an affect on, maintenance issues.

As with the other air ambulance personnel, the maintenance officer is responsible for adherence to recognized industry standards in addition to the minimum requirements of the FAR's.

3.7 MEDICAL AIRCREW RESPONSIBILITIES

The medical crew members have the greatest potential impact on day-to-day risk management next to the pilot. This impact, like the pilot's, can be positive or negative. As discussed in the introduction, the pilot in any given situation may need both operational and motivational support to ensure that the risks are kept under control. The other air crew members are in the best position to observe the pilot and assist him/her in making safe decisions.

For example, if the pilot expresses a concern about the weather, either before or during a flight, this may be an indication that he/she does not feel entirely comfortable with all aspects of the mission. This may occur even when the ceiling and visibility are well above company minimums. The appropriate response by the medical crew would be to open an objective discussion on alternatives. An inappropriate response would be to simply indicate displeasure, for whatever reason, with the indecision of the pilot.

The foregoing example is a simplification. However, accidents have occurred when the pilot, after expressing such concerns, was met with silence, or a negative response, indicating the desire of the aircrew to continue the mission as planned.

The NTSB found in their 1988 report that "The bonds established between the pilots and other crew members and EMS staff can become quite strong." This establishes crew members as an important part of the risk management process and makes them partially responsible for the safe outcome of any flight.

In addition to the decision making support role, the medical aircrew members must follow standard operating procedures and report any safety discrepancies. They should be actively involved in reviewing all safety bulletins and supporting the safety committee. They have the responsibility to reduce any unnecessary risks and to request a pilot to decline or abort a mission when, in their opinion, the risks are too high.

3.8 GROUND PERSONNEL RESPONSIBILITIES

Ground personnel include the dispatchers, schedulers, and the first responders or landing zone preparers along with any other ground-based personnel performing a support role in helicopter EMS. Each of these individuals should receive some type of formal training in risk factor control. They are also responsible for the safe conduct of the operation and should maintain current knowledge of pertinent safety hazards through review of accident and incident reports and other safety bulletins.

Ground personnel are responsible for making pilots, medical crew members and management aware of any safety hazards. They are the main interface with ground emergency medical personnel, local, and state law enforcement authorities, etc. They should attend the safety meetings on a regular basis to coordinate ground-related safety issues, changing rules or requirements, and to integrate their concerns and recommendations into the risk management support system.

4.0 RISK ASSESSMENT

In order to achieve the highest degree of safety, managers must recognize their roles and responsibilities in the risk assessment process. The impact of management on safety begins with the submittal of a bid and the successful negotiation of a hospital contract. It is at this point that the operator must inform the hospital administration of his/her standard operating procedures and risk management program. The operating limitations of the helicopter being used must be clearly stated, as well as weather minimums and the limits imposed by the FAR's. Finally, the human limitations associated with staffing, scheduling, and training must be explained. Of course, the costs of this risk management method will have already been incorporated into the contract bid price.

4.1 PILOT SCREENING, EVALUATION, AND TRAINING

Accident statistics have repeatedly proven that the pilot is the primary causal factor associated with both fatal and non-fatal accidents. Yet we have seen in Section 2.1, Pilot Characteristics, that the typical pilot's motivation and personality traits generally drive him or her to strive for success. In most accident cases, it is precisely the pilot's determination to be responsive to the needs of the hospital and do a good job for his/her management that leads to an unbroken chain of judgment errors. What can the operator do to reduce such risks? Management must take into consideration the influences that affect pilot performance and develop and utilize techniques to select and monitor their personnel. Then they must provide them with sufficient time for training, training, and more training.

Training is the most important and most controllable risk reduction method. It is the easiest to implement, once the operator has made the financial and philosophical commitment to support it. This decision can be expedited if the operator can pass the additional costs of training on to the hospital, providing they are clearly identified in the initial bid and put in proper perspective. One successful method of presenting these costs is to compile a comparison table. Show the cost of the required flight hours for proficiency training, safety clinics, and refresher training for the crew complement being bid. Then compare these costs to the average cost of the helicopter ($500,000 for a Bell 206), an accident, the avionics equipment, medical equipment (litters, oxygen system, neonatal care equipment, fire retardant flight suits, helmets, etc.). Presented in this light, the professional hospital administrator and program director will recognize that training is a relatively small, but extremely wise, investment.

Training is comprised of three aspects:

1. The minimum training required to satisfy the FAR's.
2. Proficiency training.
3. Aeronautical Decision Making (ADM) training.

The FAR aspect is, and has been, satisfied by the operators all along, but the other two are just becoming recognized as equally important. Proficiency training simply means practice in the necessary skills for safe flight. It should be tailored to suit the local geographic area and environment, the equipment being used (aircraft, avionics, etc.), the pilot's EMS experience level and the average mix of mission types (onsite pickups and inter-hospital transfers). Most important of all, every pilot must be proficient in the ability to fly the aircraft with reference to instruments whether instrument rated or not! Let's look at the facts from the recent NTSB report:

"Weather related accidents are the most common and most serious type of accidents experienced by EMS helicopters, and are also the most easily prevented."

"Reduced-visibility accidents account for 61 percent of all fatal commercial EMS helicopter accidents. All of the reduced visibility accidents occurred during a patient transport."

"Instrument ratings provide no assurance that a non-current pilot will be capable of controlling a VFR helicopter in IFR conditions. Helicopters currently used for EMS operate at cruise speeds that preclude the pilot from executing a 180 degree course reversal in a distance of less than 1/2 mile, the day VFR visibility minimum for commercial helicopter operators."

In a majority of the reduced visibility accidents, the aircraft impacts the ground at or above full cruise speed within 24 to 60 seconds after entering IMC. Therefore, the need for specialized instrument flight skills training is apparent. The program should focus on standard procedures for flying out of inadvertent IMC and maintaining attitude control while doing so.

ADM training has been recognized by regulators, manufacturers, operators, and pilots as a significant risk reduction technique since the publication of the FAA training manuals in 1987. The acceptance and utilization of this approach to risk assessment is a necessary first step in a grass roots approach. The important elements of the ADM training are illustrated in Figure 2, Grass Roots Approach.

As can be seen in figure 2, the performance of a pilot on any given day depends on the condition of the pilot on that day. Thus, performance may be affected in many different ways during any given mission.

The risk raisers that affect pilots are called "stressors." The four types of pilot stressors are:

- Physical Stress
- Physiological Stress
- Psychological Stress
- Sociological Stress

Each of these is defined and discussed in the basic ADM manual. It is the responsibility of the pilot to learn how to recognize these stressors and to help balance or neutralize their effect. Self-tests and suggestions for reducing stress are presented in the basic ***Aeronautical Decision Making for Helicopter Pilots*** manual.

The program manager, his/her safety officer, and the chief pilot should get to know each pilot well enough to be able to recognize changes in behavior that might indicate increased risk. Does he/she seem fatigued? Has he/she been ill? When was his/her last meal? Is his/her mood normal? Up? Down? Does he/she have a good attitude toward work? Has it changed recently? Has his/her personal appearance changed? Any personal problems? The Naval Safety Center has established a positive correlation between such behavioral changes and an increase in the risk of mishaps, both on and off duty (Approach, Dec. 1985).

ADM training techniques will not be repeated here except for a brief overview.

Basically, ADM training teaches pilots how to recognize unsafe attitudes in themselves and correct the unsafe behavior normally associated with these attitudes through better decision-making. The crux of this part of the training is the self assessment attitude inventory and the reinforcement exercises. The role of the aviation manager in the ADM process is to provide the initial training, to stress its importance in risk management and to ensure that pilots maintain a continuous awareness of the importance of safe attitudes in accident reduction.

The second aspect of ADM training is to provide both the pilots and management with a day-to-day risk assessment technique. This is done through the assessment of risks prior to launching a flight. As shown in Figure 3., Managerial Control of ADM Risk Elements, the condition of the Pilot, the Aircraft, the Environment, and the demands of the Operation should be carefully evaluated. The final go/no-go decision must always remain with the pilot, techniques for managerial control of these four basic risk elements will be discussed in Section 4.2, The Systems Approach.

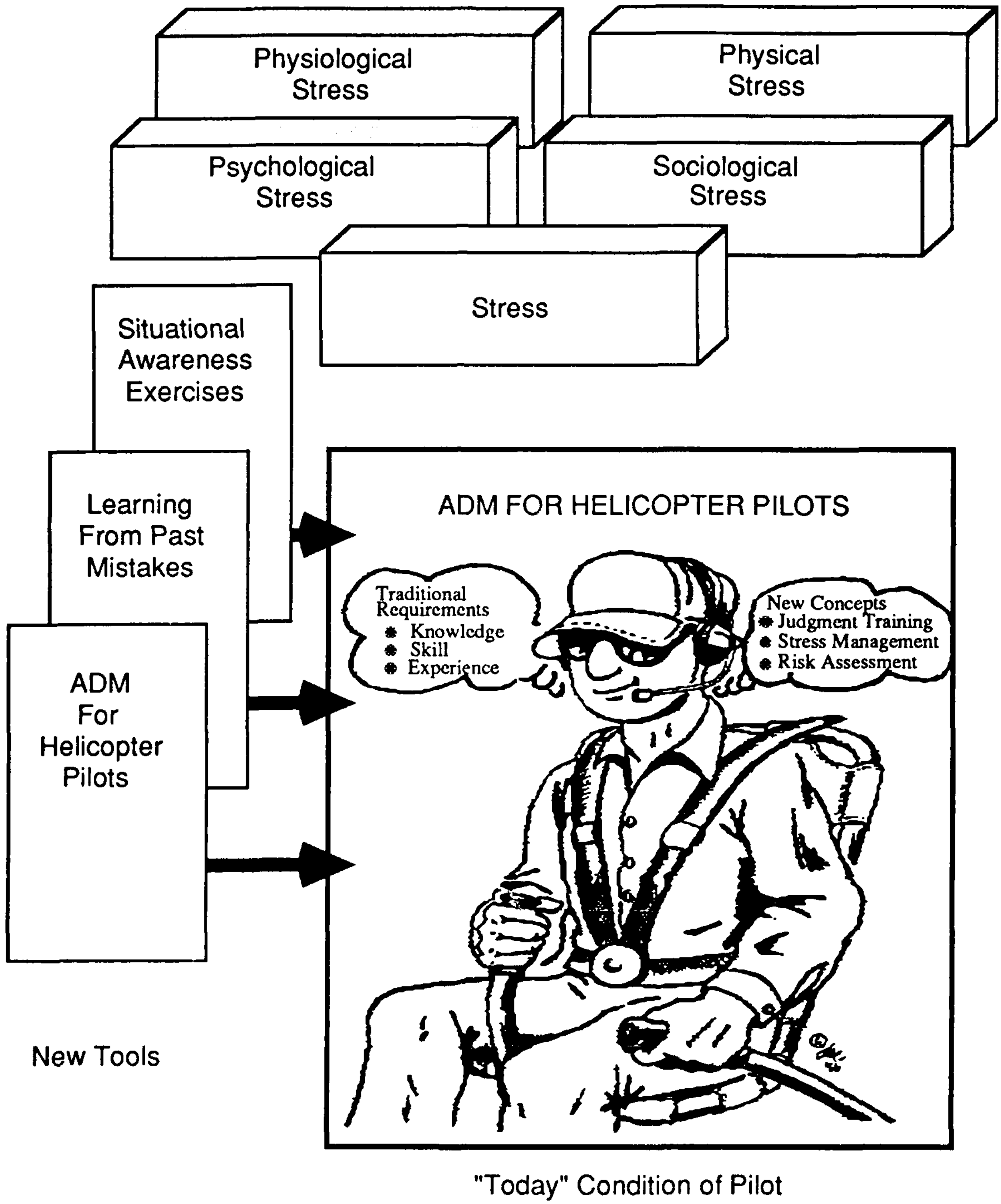


Figure 2. Grass Roots Approach

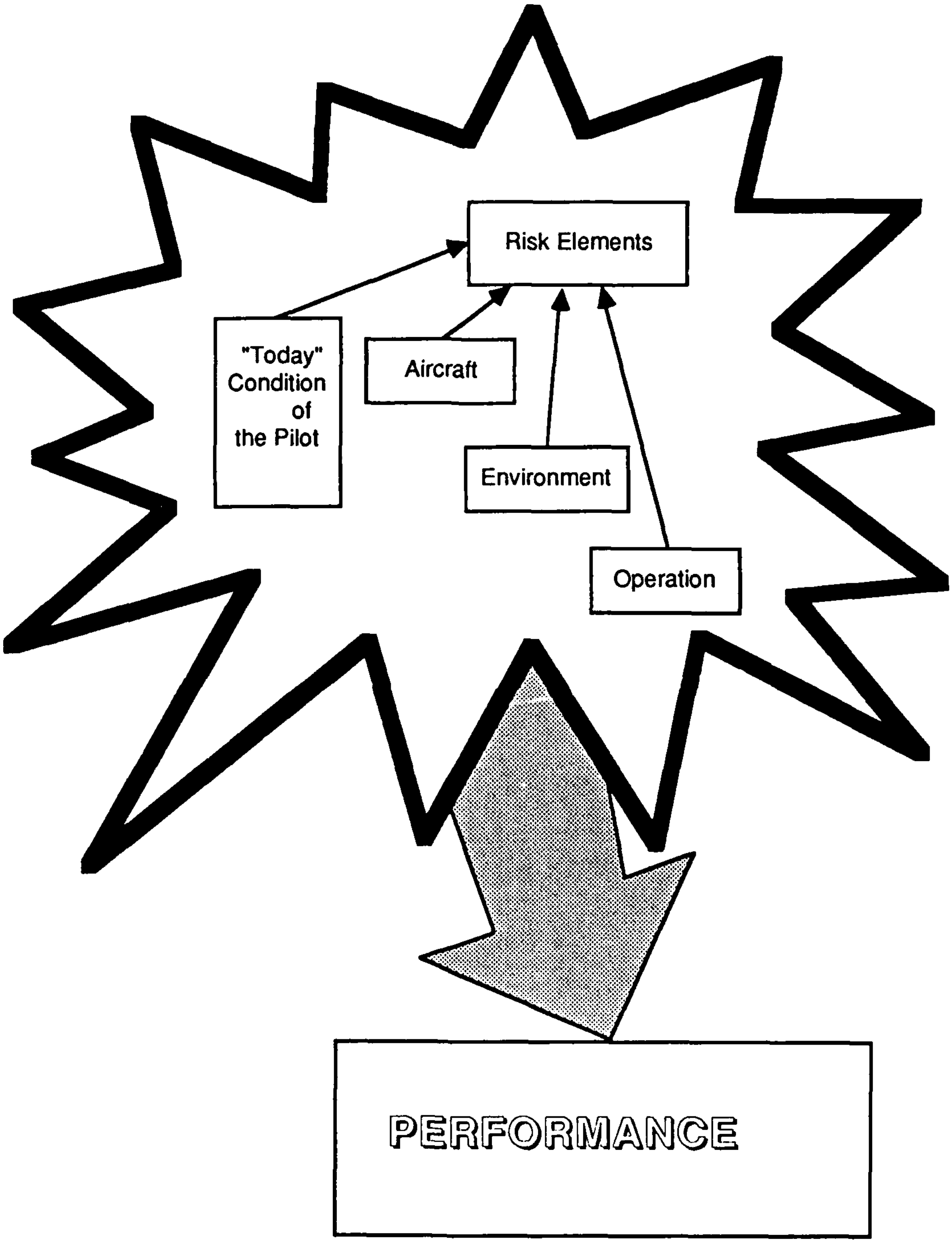


Figure 3. Managerial Control of ADM Risk Elements

Finally, ADM training teaches pilots how to maintain a higher degree of situational awareness. This is done through the use of the "DECIDE" model which is a mnemonic for a risk assessment process:

D – Detect change
E – Estimate significance
C – Choose objectives
I – Identify options
D – Do best option
E – Evaluate progress

This simple model (Jensen and Lawton, 1987) offers a structured process for something pilots usually do in an informal manner anyway. However, it is a matter of statistical record that many accidents occurred because a deteriorating situation was detected too late, the significance of the deterioration was not recognized or, once recognized, no action or the wrong action was taken. The Jensen and Lawton data has shown that pilots with a high degree of situational awareness are safer pilots.

The last operator consideration in pilot risk assessment is the one that needs to be accomplished first. It was saved for last because it is the most difficult to implement. Gaining an understanding of pilot capabilities and limitations through initial screening and with periodic monitoring is a responsibility that cannot be overemphasized.

During the job interview phase, it is important to develop questions, assessment procedures, and evaluation procedures that you feel can screen out the takers of undue risk. One method used by some operators is the use of role playing in hypothetical mission situations. Three to five mission scenarios typical of the job can be used. Each scenario should increase the difficulty of performing a successful flight and the emotional stress on the candidate's decision making. For example, the candidate could be asked to rate the risk of the following scenarios on a scale of 1 to 10 with 1 being the least risk and 10 being unacceptable for safe flight. He/she is also asked for a go/no-go decision in each case. The following examples are provided (however, using actual scenarios based on past missions is strongly recommended to achieve a stronger impact):

1. You are part of a single helicopter, four pilot operation. You are working a 12-hour duty cycle with four days on followed by four days off. It is near the end of your fourth swing shift, say 3 a.m. on a 7 p.m.-7 a.m. shift. The weather is 500 foot ceilings with 1/2 mile visibility, temperature 57 degrees, dew point 46 degrees. You are asked to make a repositioning flight for an inter-hospital transfer.

Rate the risks of Pilot (P), Aircraft (A), Environment (E), and the Operation (O) on a scale of 1 to 10. Would you take this flight? Why or why not?

2. Same scenario except the temperature is reported as 47 degrees, and there are two local lakes that will have to be overflown to get to the destination helipad.

Rate the risks P, A, E, O. Would you go?

3. Same scenario as 1. except it is an onsite pickup in an unfamiliar area.

Rate the risks P, A, E, O. Would you go?

4. You see a truck accident victim brought into the emergency room with massive head injuries. You immediately realize that he will have to be taken to a trauma center 90 miles away so you begin to prepare for the flight by checking weather

with Flight Service. It is 7 a.m. on the first day of your duty cycle. They report 700 foot ceilings, overcast, with 1 1/2 miles visibility in light drizzle and fog, 47 degree temperature 43 degree dewpoint. You take off 45 minutes later on a LORAN-C direct flight at a planned altitude of 2,200 feet. Upon reaching altitude, you have no horizon and inadequate ground references, but you can see the glow of traffic lights on the interstate below that leads to your destination. Highest terrain between you and the destination hospital is 1,300 feet. You head toward the interstate but begin to encounter wispy clouds sloping down and away toward the highway.

Rate the risks P, A, E, O. Would you go?

5. Same scenario as 4. except the accident victim is your mother.

Rate the risks P, A, E, O. Would you go?

These types of scenarios and the risk evaluation discussion can reveal a great deal about a pilot candidate. Although there is a tendency to get the text book answer in such an evaluation, discussing the pilot's logic for that answer as well as analyzing how that logic changes as the scenarios gradually deteriorate will provide a valuable comparison of candidates. This evaluation of decision making should be used, in conjunction with related EMS experience level, pilot time in make and model of the helicopter to be used, and the other normal candidate evaluation factors to select the most qualified candidate.

What about monitoring and continued (annual) evaluation of the pilot risk factor after selection and initial ADM training? This is another very difficult but achievable task. The operator should establish some type of evaluation procedure to be used along with flight currency checks. There are at least three options. First, an annual evaluation of pilot decision making skills could be a part of regular currency training and check rides. This could be accomplished by integrating judgment related items into the check ride itself. For example, the following types of judgment test items could be used within the limits of safety: laying the cover of the horizontal stabilizer on the helipad, kicking a tiedown over one skid during preflight, asking the pilot to land too close to other helicopters, asking the pilot to fly below 500 feet over a densely populated area, or asking him/her to make a steep, downwind approach to save time.

The second method would be to have the pilots develop risk assessment scenarios of their own based upon either the past experiences (close calls) or NTSB accident case files. They could exchange their scenarios, rate the risks, make hypothetical go/no-go decisions and then discuss and analyze their conclusions with each other, the safety officer and the chief pilot. This creates an atmosphere in which positive reinforcement of risk assessment and safe decisions by one's peers takes place. It also provides pilots with a non-self-deprecating way to express circumstances, procedures, or operations they may feel are unsafe. Such feedback benefits the operator through reduced accidents and incidents, and consequently lower hull and liability insurance rates and more contracts.

The third alternative is to quantitatively evaluate the hazardous pilot attitudes annually during the check ride. The advantage to this technique is that it can effectively be used to monitor a pilot's behavioral change as he/she gains experience, matures, goes through personal crises, etc. A technique that has been developed and used successfully will be briefly reviewed for consideration.

As stated previously, the actual testing for good judgment is difficult, but not impossible. Mr. Denis A. Caravella with the FAA Great Lakes Region General Aviation District Office 3 has

developed a system to quantify the hazardous attitudes which the pilots were trained to avoid in the basic ADM course. He/she uses rating scales as follows for each attitude.

	Aggressive---Timid										
MACHO –	5	4	3	2	1	0	1	2	3	4	5
	Defiant--Conformist										
ANTI-AUTHORITY –	5	4	3	2	1	0	1	2	3	4	5
	Insistent--Yielding										
RESIGNATION –	5	4	3	2	1	0	1	2	3	4	5
	Spontaneous---------------------------------------Pondering										
IMPULSIVITY –	5	4	3	2	1	0	1	2	3	4	5
	Carefree---Trepid										
INVULNERABILITY –	5	4	3	2	1	0	1	2	3	4	5

The definitions of these extremes as well as examples of how they can be used by the operator to evaluate pilot judgment are provided in Appendix A, The Evaluation of Pilot Judgment During Certification Flight Tests. The check pilot can use the standard five hazardous attitudes as a means of rating judgment as follows. Each hazardous thought pattern is not to be thought of as isolated. Rather, each pattern is to be thought of as only one possibility between two extremes. For example, the hazardous attitude of RESIGNATION implies that a pilot relinquishes control or decision making to some outside force or influence and that the resulting outcome of a task is beyond the control of the pilot. The check pilot would recognize this hazardous attitude by the pilot "giving up" during the attempted accomplishment of a task or by relinquishing responsibility or control.

The antithesis of this would be observed in a pilot with a "do or die" attitude. This pilot would be characterized by one who insists that only he/she can control outcomes and that outside influences such as weather, fatigue, and aircraft performance are not influential. This pilot would probably not recognize limitations as being necessary considerations. This pilot is different from the MACHO pilot in that the MACHO pilot recognizes limitations but simply believes he/she can overcome them. It can be seen that the RESIGNATION attitude ranges from giving up to do or die and that the act of resigning is just one extreme of the range.

Each hazardous attitude is similarly described in detail in appendix A along with an explicit discussion of how to recognize and evaluate the extremes. As shown above, the check pilot will be evaluating judgment along five different ranges (one for each hazardous attitude). The check pilot will be looking for a balance between the two extremes involved in each hazardous attitude. He/she will grade each task that is performed by the pilot along the ranges of the appropriate hazardous attitude. For example:

TASK - PREFLIGHT WEATHER BRIEFING - HAZARDOUS ATTITUDE

	Aggressive---Timid										
MACHO –	5	4	3	2	1	0	1	2	3	4	5
Rating:		X									

HAZARDOUS BEHAVIOR: Cut briefer short on telephone, entered IMC during flight

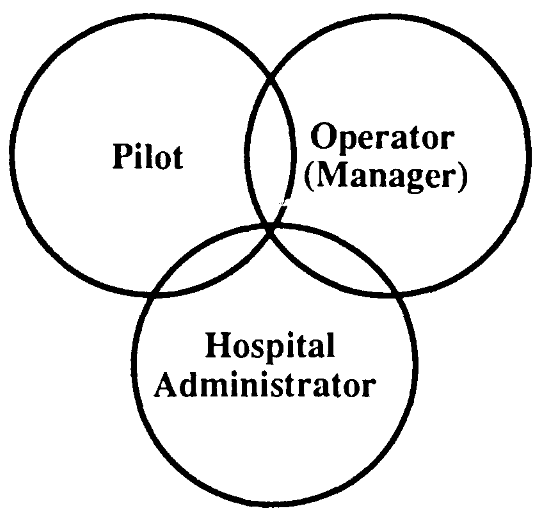
It is suggested that each case of a four or greater score would need to be backed up by an observed unsatisfactory behavior or outcome for it to be considered unsatisfactory in itself. It is assumed during such grading that the check pilot would accurately evaluate the pilot's level of competence so that an acceptable determination of attitudes and decision making skills can be made.

This evaluation procedure is just an example. It can be used in conjunction with the more complete discussion and additional illustrative examples in appendix A to develop a complete pilot risk assessment and evaluation system.

4.2 THE SYSTEMS APPROACH

Remembering the discussion in Section 2, Operational Pitfalls, on pilot motivational traps and system-generated risk, it becomes clear that even with thorough screening, ADM training and diligent monitoring, the pilot cannot be held solely responsible for risk reduction or the sole focus of a successful risk management program. Ultimately he/she makes the final decision to take a mission, but needs written standard operating procedures and a strong management support system to influence his/her day-to-day decisions consistently on the side of reduced risks.

The diagrammatic logic of John Venn, an English logician, is portrayed in the "three-ring" sign. A Venn diagram showing the relationship of the integrated areas which create a systems approach to risk management is depicted in Figure 4, The Systems Approach to Risk Management.



Figur^ 4. The Systems Approach to Risk Management

System risk assessment is that part of the risk reduction program dealing with the broad aspects of mission planning over which management has control. It includes the usual risk elements of Pilot, Aircraft, Environment, and Operation that are shared with the pilot. It also includes the broader elements of the system over which management has primary responsibility.

As illustrated in Figure 5., Risk Management Starts Here, decisions made at this level provide the foundation for either a very conservative, safe, minimum risk operation or an unsafe, high risk operation.

Figure 5. Risk Management Starts Here

Finally, it is the primary responsibility of the Part 135 vendor to convey the capabilities, limitations, and costs of the operation to the hospital program administration. He/she must adopt a responsible posture showing a willingness to satisfy the hospitals needs, but an unwillingness to exceed safe operating limits. That is what is meant by "strong management support system" for the pilot's decisions.

The operator's role does not end here. Strong support must be documented and implemented for each specific hospital contract. It is recommended that the Chief pilot, the

safety officer, and the hospital program director and as many of the other aeromedical team as practical, jointly discuss standards of operation, practical, safe operating limits and the means of assuring compliance. This process should produce a usable, Standard Operating Procedures (SOP) manual as a result.

4.2.1 Criticality of the SOP

The high liability, high profile nature of an air ambulance operation requires the SOP to address not only the safe operation of the aviation unit, but also cover all applicable local, state and Federal regulations and any problems that the operator perceives as unique to the unit. Adherence to the SOP must be the primary concern of management in order to reduce risk exposure and to protect themselves from liability. The following topical outline (adapted from ALEA's Executive/Management Couse, July 1987) is provided as a starting point for the development of an SOP:

A. Operational Objectives – what are the primary things the unit is going to do?

B. Priorities
  1. Inter-hospital transport
     a. patients
     b. organs
     c. blood
     d. supplies
     e. other
  2. Onsite pickups
  3. Other

C. Deployment
  1. Protocols with hospitals served
  2. Protocols with other responding agencies
  3. Letters of understanding, letters of agreement or other compacts
  4. Air Traffic Control (ATC) priority, procedures or protocal

D. Operations
  1. General
  2. Inter-hospital operations
  3. Onsite operations
  4. Weather minimums
  5. Maintenance
  6. Unacceptable launch conditions
  7. Training
  8. Personnel limits

E. Logistics
  1. Facilities
  2. Equipment
  3. Communications – dispatch, other aircraft, FAA control towers, medical
  4. Fuel
  5. Supplies
  6. Agreements to provide maintenance at remote sites

F. Legal
  1. Federal Aviation Regulations
  2. State aviation regulations

3. Local regulations, zoning, ordinances, etc.
4. Liability

G. Personnel
1. Selection and duties – supervisors, chief pilots, safety officer, training officer (may be chief pilot or line pilot), maintenance officer, pilots, etc.
2. Reporting for duty
3. Stress Management
4. Illness
5. Personal appearance, conduct, etc.
6. Uniform
7. On-call call out
7. Discipline

H. Safety
1. Accident prevention
2. Risk reduction
3. Dispatch - go/no-go
4. Ground handling
5. Maintenance
6. Specialized crew training (pilots, aeromedical, dispatch, maintenance)
7. First responders (ground ambulances, police, fire, other)
8. Unprepared landing zone preparation and procedures
9. Other Policies

I. Records and Forms
1. Pilot flight logs
2. Activity summary
3. Fuel usage reports
4. Aircraft flight time
5. Pilot training records
6. Medical records
7. Flight physical records
8. Maintenance records
9. Dispatch records
10. Inventory records
    a. Purchasing
    b. Backlog
    c. Requirements

J. Maintenance
1. Legal requirements – FAA, maintenance manuals, aircraft owners manuals, mechanic legal certification, mechanics limitation
2. Safety – equipment, tools, fuel, inspections, overhauls, backup inspections, procedures
3. General – required schools for certification, navigation, electronic, engine, airframe.
4. Medical – equipment, installation and maintenance

K. Training
1. Initial
2. Recurrent
3. Instrument
4. Decision making
5. Situational awareness
6. Risk management

7. Stress management
8. Crew resource management

L. Internal Relations
1. Onsite
2. Operator (management)
3. Hospital administration
4. Other aeromedical personnel

M. External Relations
1. Media relations
2. Community relations
3. Speaker bureaus
4. Fly Neighborly guidelines
5. HeliProps

4.2.2 Functions of Risk Management

An excellent discussion of classic system safety methodology applied to hospital safety appeared in *Professional Safety,* March 1980 by Dr. Vernon Grose. In the article Dr. Grose lists the functions of risk management as the following:

- Administration of risk-related tasks
- Identification of risk exposure
- Evaluation of identified risks
- Control of significant risks
- Financing of uncontrolled risks

In order to apply the systems approach in risk management, it is necessary to define what we mean by hazards. In the air ambulance environment, "a hazard is a condition, actual or potential, that can bring about personnel injury, or death, or damage to, or loss of property, materials, or reputation" (McLean, 1987).

The systems approach leading to control of these risks involves the following rationale as stated in the reference.

1. *"Every mission has some degree of risk exposure"*
2. *"All of the risks may never be known"*
3. *"Every mission requires balancing risks vs. preconceived parameters defined to control risk"*
4. *"Resources available to identify and manage risks are limited"*
5. *"The goal is to control or eliminate all unacceptable risks in each mission"*

This rationale implies that: there is a method to identify "all unacceptable risks"; and, that means is a part of the written SOP Due to the individual differences of each operator and the particular hospitals and regions of operations, the specified risk assessment process will have to be developed individually. However the next section is an example of one risk assessment process that has a record of success.

4.2.3 Risk Assessment

The Nightingale service based at Norfolk General Hospital has completed nearly 3,000 missions since February 25, 1982 – all without an accident. The Lead Pilot/Base Manager, Mr.

Richard J. Fedorowicz, uses screening questions similar to those provided in Section 4.1, Pilot Screening, Evaluation, and Training, when interviewing EMS pilot candidates. He also has adapted a risk management technique, developed by the Army, for Nightingale's operation. The process involves the following six important steps:

1. Risk identification
2. Risk evaluation and quantification
3. Risk reduction
4. Risk decision making
5. Risk decision follow through
6. Risk Research

The basic, underlying operational philosophy of Nightingale, as stated by Fedorowicz, is "We cannot save the world." Putting this into practice, resulted in a 9 percent refusal of missions during the first 5 years of operation (260 refusals out of 2,934 requests). All of these missions were refused because of unacceptable weather conditions, the single greatest risk factor associated with air ambulance operations. Operators and hospital administrators must recognize and be willing to accept this magnitude of refused missions, about two percent per year, if they are sincere about improving safety.

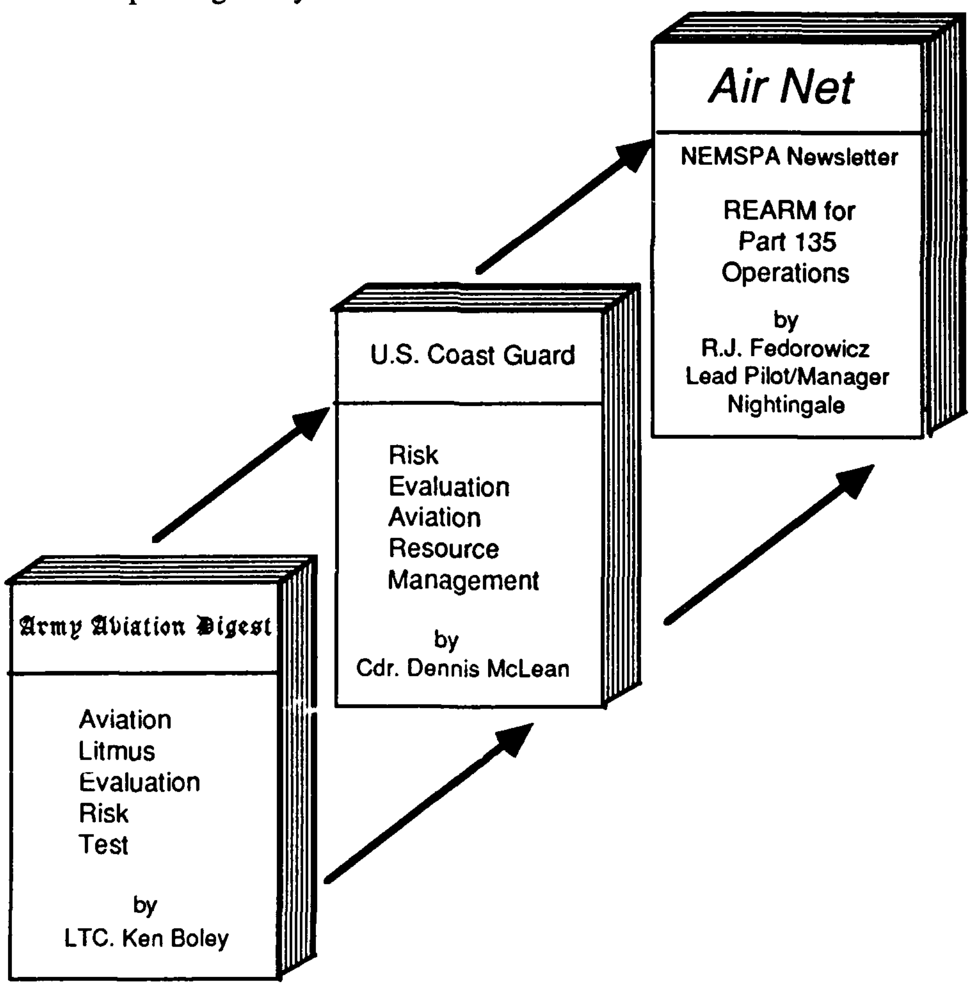


Figure 6. Anthology of a Successful Risk Assessment Method

Originally the method was developed by Lieutenant Colonel Ken Boley at the Army Aviation Safety Center, Fort Rucker, Alabama. He named the risk assessment method ALERT (Aviation Litmus Evaluation Risk Test) and assigned risk values to elements which could impact safe mission accomplishment. The elements selected were:

- Supervision
- Planning
- Crew Selection
- Crew Rest
- Weather
- Mission Complexity

The Coast Guard discovered the usefulness of ALERT and adapted these same risk elements to their risk assessment method. Commander Dennis McLean of the Flight Safety Branch called his method REARM (Risk Evaluation and Aviation Resource Management). Commander McLean modified ALERT and the values given to each of the risk elements for Coast Guard missions based upon accident and incident data.

Finally, Fedorowicz utilized the basic systems approach and applied these same concepts to Part 135 air ambulance operations with notable success. The systems approach upon which a total risk value is determined is shown schematically in Figure 7., Summing the Risk Elements.

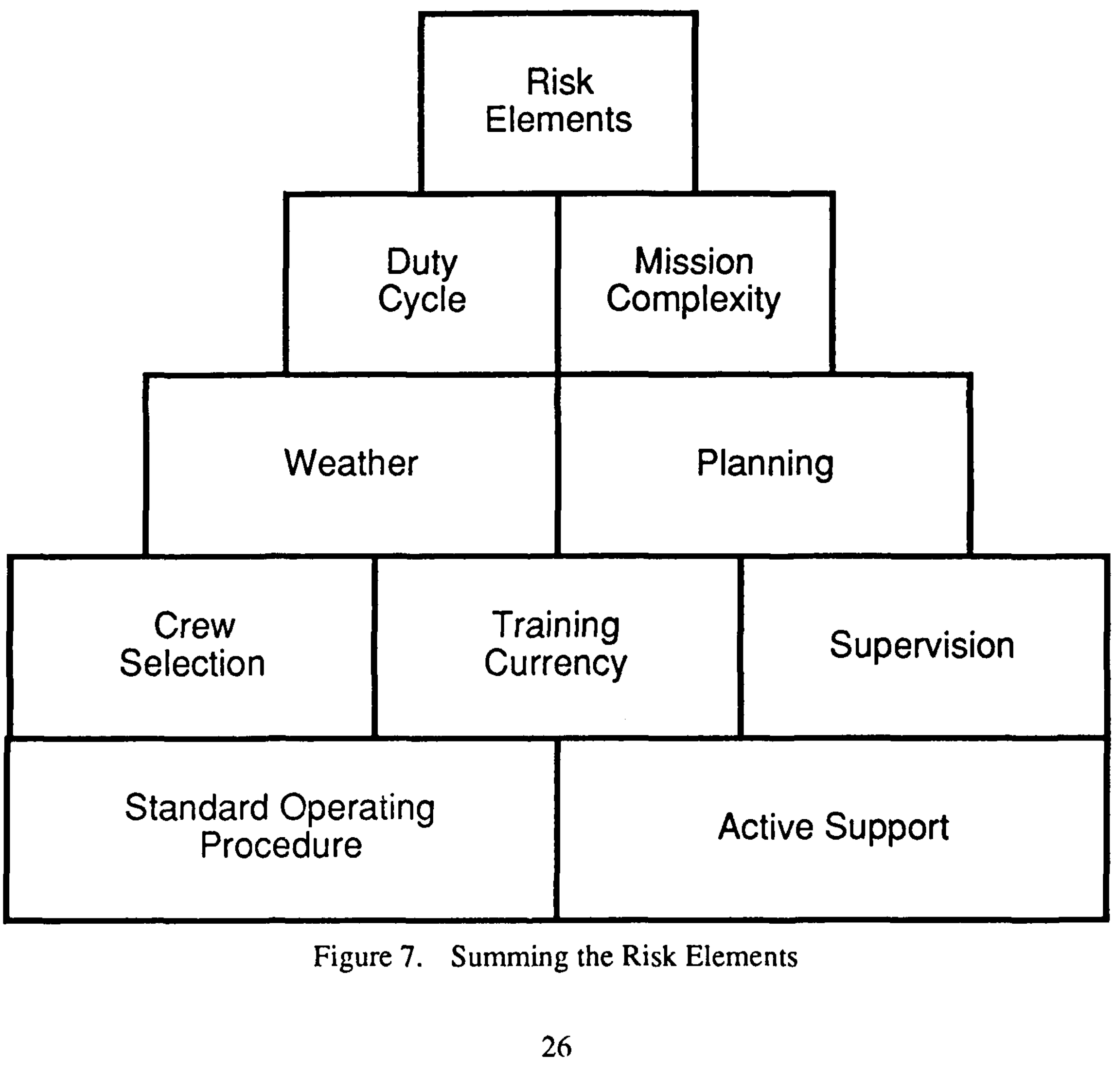


Figure 7. Summing the Risk Elements

Based upon the foundation of an SOP and strong management support, the REARM method assigns a value for each of the six risk elements and then sums the elements to obtain a total risk assessment for a particular mission on a specific day and time. The entire REARM method is described in Appendix B, Risk Evaluation and Aviation Resource Managment, which is an article written by Mr. Fedorowicz for the National EMS Pilots Association's *Air Net* newsletter. A brief overview of one way to assess air ambulance risk follows. If you are already familiar with or using REARM, skip to the last section on the Primary Risk Control Concerns.

First, the risk elements must be defined. An inaugural meeting of the safety committee is a good way to treat this comprehensively. The Nightingale definitions include the following:

SUPERVISION: The level of supervision is assessed by comparing mission type to managerial control. Three graduated mission types are considered: a preplanned site visit, a hospital to hospital transfer, and a scene pickup. Similarly, three levels of management control are considered:

1. Aviation Management (least risk) by the vendor, flight operations manager, or chief/lead pilot.

2. Independent Operations Management (moderate risk) by the duty pilot.

3. Non-Aviation Management (highest risk) by the hospital program director, chief flight nurse, medical director, and untrained scene personnel.

Unfortunately, the NTSB found the latter to be the case more often than not due to the offsite vendor location and the strong bonds that evolve between those who work together daily in a stressful decision making environment. Operators must make a strong effort to combat this risk situation or eliminate it. If they are unable to do the latter, then compensating risk balancing actions must be taken in the SOP. The technique used and the risk values assigned for the various combinations of supervision and mission risk are provided in appendix B.

PLANNING: This risk element is a trade off between time for planning and the level of guidance it provides. If the planning risk factor is judged to be inadequate, then a preconceived safety parameter has been violated and the operational risk is unacceptable. Guidance provided ranges between specific, implied, and vague. Specific guidance and extended preparation time are viewed as contributing to the lowest achievable planning risk.

CREW SELECTION: The risks associated with crew selection are assessed by comparing total crew experience with the mission risk factor. The REARM technique of appendix B recommends using related EMS flight hours only. The statistical accident data has shown that the EMS accident risk is just as high for a 14,000 hour, instrumented rated bush pilot as it is for the 1,400 hour non-instrument rated pilot if neither one has had significant EMS flying experience. It is up to each operator and the safety committee to establish acceptable crew experience risk factors for each operation. REARM uses 1-5 years, 6-12 months, and 1-6 months as low, medium, and high risk ranges. The same mission risk elements used in Supervision, are used here. Example ratings are provided in appendix B.

CREW ENDURANCE: Weighing the quality and quantity of rest against the mission risk element provides the crew endurance risk value. Again, each operator must address these variables in the SOP. Recommended risk values for three levels of rest should be

determined. The value categories typically used are optimum, adequate, and minimal. Again, minimal means the minimum acceptable rest for an operational risk that is judged acceptable. Any value less is operationally unacceptable and the mission should not be allowed.

WEATHER: As previously stated, this is the highest risk element and the reason the largest majority of mission are scrubbed. Risk assessment involves comparing wind velocity to ceiling and visibility. The lowest ceiling, visibility, and wind velocity allowed by the SOP or other appropriate directives (whichever is higher) should be used. Night operations increase the weather risk element by 2.5. Therefore, the weather risk value should be adjusted by this amount for a mission at night as is noted in appendix B, very light winds are given a higher risk value than winds of 10 knots or greater. This is predicated on the beneficial effects of wind when taking off and landing at high gross weight and the reduced likelihood of fog.

MISSION COMPLEXITY: This risk element is assessed by evaluating crew mission time, the operational environment, and the type of landing areas to be used. Crew mission time includes preparation and planning time and does not end until the aircraft is tied down after the mission. Crew mission time risks are defined at the levels of one hour (low), two hours (moderate), and four hours (high). Landing area risks vary from full heliport facilities through helipad to unknown.

It should be noted that an attempt was made to incorporate a risk factor relating to single engine vs. twin engine but the current data (1,500 Coast Guard missions) showed no significant difference in the number of flight hours between mishaps, or the magnitude of the mishaps. This factor should be reexamined at a later date when sufficient flight hour data and mishap experience has been recorded.

4.3 SUMMARY

The systems approach to risk management recognizes the interaction of all the involved areas and establishes a risk value for each. The overall risk is then determined and compared with preconceived parameters that reflect the operator's definition of safety (see Section 3.0, Risk Management).

Gradations of normal operational risks, both acceptable and unacceptable, may then be used to classify a mission or operation. If the risks are unacceptable, the operator has three choices. He/she can cancel the mission; he/she can take immediate action to reduce the risk to acceptable levels, such as using a more experienced pilot or adding a second pilot; or he/she can wait until one or more of the risk factors changes, such as postponing the flight until the weather improves.

Figure 8., Optimizing Managerial Control of Risks, illustrates the progression from uncontrolled risk, to independent risk management and finally to managerial control using the system approach. Obviously, the uncontrolled risk scenario has just about disappeared from aviation in general and air ambulance operations in particular. Independently (duty pilot) controlled risk is a delicate situation that depends upon consistent flawless performance by the pilot even when under adverse and changing circumstances. Any mistakes, oversights, or underestimation of risks can result in an accident or incident. However the managerial control of risk through the systems approach provides an optimal set of checks and balances that assures risk reduction. As shown in figure 8, two important and desirable by-products of management's involvement in the process are improved safety and reduced liability costs.

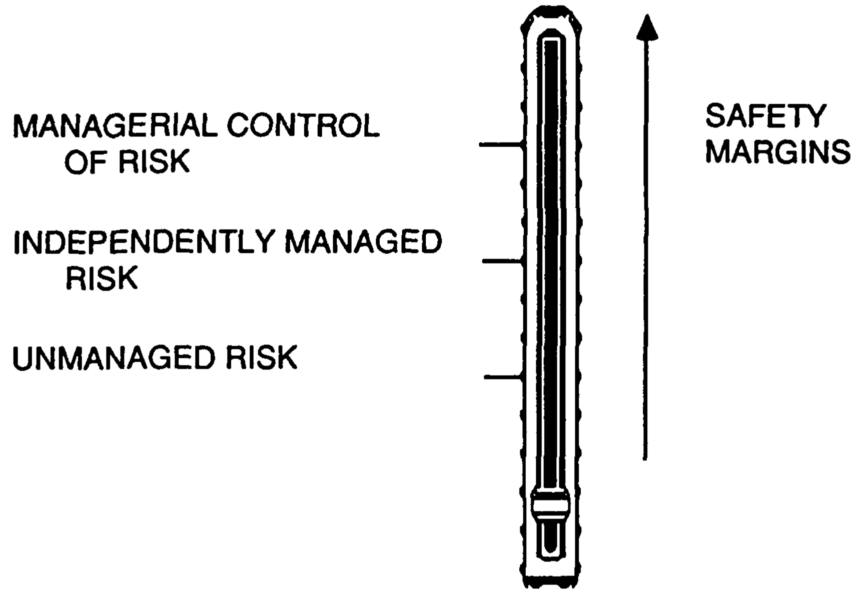


Figure 8. Optimizing Managerial Control of Risks

In conclusion, the air ambulance vendor manager has a "big picture" perspective and is responsible for the effectiveness of the risk management program and liable for any shortcomings or failures. His/her decisions directly impact the "bottom line" as well as personnel and equipment risk exposure. This section has described the managers role and responsibility for reducing risks in some detail. Hopefully, knowing the rules for safe operations and using the tools provided herein, continued improvements in air ambulance safety records will be possible.

5.0 KEY AIR AMBULANCE OPERATOR CONCERNS

This manual was prepared to point out the significant role and responsibility of management in the risk assessment and control process. It has provided the reader with new insights into a very complex and important aspect of the air ambulance operations.

The following are two points to be retained and put into every day practice. First, risk management begins with communication of the operating limitations of both pilots and helicopters to the hospital administration and the hospital program director. Second, the pilot is the focus in the risk management chain. His or hers is also the most manageable risk. He/she needs to be adequately trained and kept current. He/she needs the understanding of support management to overcome his/her innate characteristics which, under certain circumstances can result in a tendency to make less than the best decisions.

The preceding pages have presented the preferred systems approach to risk assessment and management. The techniques and tools discussed were not for the most parts, new. Many of the 150+ commercial air ambulance operators are using these methods with considerable success as evidenced by the dramatic improvement in the 1987 EMS accident rate. Continued awareness and risk management is required to maintain this performance. The primary purpose of this manual is to collect all of the best of what is being used successfully in a compendium to be integrated into a comprehensive program for risk management.

The purpose of this section is to summarize and highlight the key risk elements from a manager's perspective. This will serve as a checklist to help determine the strengths, weaknesses, and required improvements in a risk management program. There are four areas requiring attention, from a risk assessment viewpoint:

- Training
- Management
- Operations
- Fatigue

5.1 TRAINING

Pilots: The key requirement is to give the pilot the tools he/she needs to perform his/her missions. These tools include the ability to maintain attitude control of the helicopter in the case of inadvertent IMC. However, there are several additional training issues of nearly equal importance. These are:

1. Geographical orientation.
2. Weather forecasting and interpretation.
3. Local weather phenomena.
4. Standard procedures for unwanted IMC.
5 Weather reporting and reliability.
6. Wire, terrain, and object strike accidents.
7. ADM and risk management training.

Medical Personnel: The chief concern here is to provide the aeromedical crew with sufficient knowledge and training to add an extra degree of safety to the operation. Of primary concern from a training viewpoint are the following:

1. Obstacle avoidance on approach and departure.
2. Scanning for air traffic during cruise.
3. Assisting the pilot during routine radio calls to the dispatcher or ATC.
4. Helicopter shutdown in emergencies (pilot incapacitation).
5. Mayday procedures.
6. Operation of Special Type Certificated (STC) equipment.
7. Minimum FAR Part 135.331 training.

Non flying personnel: Although not a contractual requirement, the training of first responders and public safety personnel is strongly recommended. This training should include, but not be limited to, the following:

1. Landing zone selection and preparation.
2. Day and night operations.
3. Landing zone security.
4. Assisting the crew.
5. Helicopter ground safety.

5.2 MANAGEMENT

There are two basic ingredients to a successful risk management program. They are: communication of man and machine limitations to the hospital administration; and strong support of the pilots in their daily risk management decisions. These can be assured by applying the following techniques:

1. Pilot selection and screening to eliminate obvious risk takers through the use of:
   - EMS experience not just total flight hours
   - screening scenarios
   - judgment check ride

2. A written set of Standard Operating Procedures.

3. Development of a strong safety program that features:
   - support of the pilot's decisions
   - regular safety meetings
   - periodic communications on safety
   - appointment and support of chief pilot to evaluate operations periodically
   - appointment and support of a safety officer to ensure communication
   - conduct safety meetings and attend regularly

5.3 OPERATIONS

There are three key concerns in this area. First, the manager must program the time and cost of training into the bid process at the beginning. Second, he/she must communicate the operating limitations to the hospital and clearly state that he/she will not be influenced by competition from other local programs. Third, he/she must develop a method to protect the pilots from the subtle pressure, both self-induced and peer induced, associated with the strong bonds that develop between the aeromedical crew and the pilots.

5.4 FATIGUE

Although no scientific studies have been able statistically to link accident rates to fatigue, it is an emotional issue of strong concern to pilots, and one that common sense dictates should be taken seriously. The managers risk management program must include adequate provisions for the minimization of both acute and chronic fatigue. The first place to employ fatigue minimization procedures is in the determination of crew sizes and duty cycles. Several government agencies and industry groups have published recommendations, standards, and guidelines.

The second consideration in this area is the effect of stress and fatigue. The basic ADM manual for helicopter pilots treats these issues from the perspective of the individual pilot. The manual defines the primary stressors are:

1. Physical
2. Physiological
3. Psychological
4. Sociological

Of these, sociological stress has been found to have the most significant long-term effect. Managers should be particularly aware of and sensitive to the familiar and disruptions that are typical of air ambulance duty. Stress alleviation methods such as mental health days, family support activities, and other improvements to this sociologically stressful environment should be considered.

EPILOGUE

The conscientious resolution of all of these key concerns will not totally eliminate helicopter air ambulance accidents. However, if these important risk elements are systematically addressed and controlled, a significant improvement in safety will become a reality.

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APPENDIX A

THE EVALUATION OF PILOT JUDGMENT

DURING

CERTIFICATION FLIGHT TESTS

by

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INTRODUCTION

The evaluation/certification of pilot judgment may be determined by pilot examiners through observation of required pilot operations as described in the appropriate test standard. This guide deals with the private pilot applicant.

Pilot examiners knowledgeable of judgment applications recognize that while any given task, as described in the practical test standard, may be performed satisfactorily when compared to the maximum allowed deviation from numbers, i.e., airspeed, altitude, heading, the task may still be rated unsatisfactory based upon the exercise of pilot judgment by the applicant. This somewhat more subjective assessment of the applicant, however, can be standardized for pilot examiners. It is anticipated that the application of poor judgments may also, but not always, result in unsatisfactory aircraft control.

When evaluating pilot judgment, examiners may use the standard five hazardous thought patterns as a basis for determination. Each hazardous thought pattern, however, is not to be thought of as isolated: it is, for the purpose of evaluation, only one of two extremes in a though pattern range. For example, the hazardous thought pattern of RESIGNATION implies that a pilot relinquishes control or decision making to some outside force or influence, and that the resulting outcome of a task is, therefore, beyond the control of that pilot. A pilot examiner would recognize the exercises of this hazardous thought pattern by witnessing the pilot "giving up" during the attempted accomplishment of a task or by relinquishing responsibility or control.

The extreme antithesis of this would be observed in a pilot with a "do or die" attitude. This pilot would be characterized by one who insists that only he or she may direct outcomes and that outside influences such as weather, fatigue, and aircraft performance are not influential. This pilot would probably not recognize limitations as being necessary considerations. This pilot is different from the MACHO pilot in that the MACHO pilot recognizes limitations but simply believes he or she can overcome them. It can be seen, then, that RESIGNATION ranges from giving up to do or die and that the act of resigning is just one extreme of the range.

Each hazardous thought pattern range, then, must be described in detail. As will be discussed, the pilot examiner will be evaluating a pilot applicant during each required task along five different ranges; one range for each hazardous thought pattern. The pilot examiner will be looking for a balance between the two extremes involved in each hazardous thought pattern. This discussion will be general in nature in order to simply introduce the concepts.

MACHO HAZARDOUS THOUGHT PATTERN

AGGRESSIVE
FORCEFUL -- TIMID
5 4 3 2 1 0 1 2 3 4 5

During the evaluation of tasks observed by the pilot examiner, a balance between the two extremes shown above must be displayed by the pilot applicant.

DEFINITIONS

AGGRESSIVE / FORCEFUL is defined as behavior characterized by the use of obtrusive energy in pursuit of a particular goal.

TIMID is defined as behavior displaying a lack of self-confidence and/or determination.

AGGRESSIVE / FORCEFUL

Typically, an AGGRESSIVE / FORCEFUL pilot will appear to be unreasonably challenging, bold, and belligerent with people encountered during preflight operations. This pilot may, without cause, challenge the accuracy of forecast weather, demand that dispatch personnel act according to his or her wishes, be overly critical of line personnel and air traffic controllers, and appear to be generally demanding without considering others.

In the aircraft the AGGRESSIVE / FORCEFUL pilot may make abrupt, rapid, and large control inputs. He or she flies without smoothness and may become agitated with delays and jockey for position at runways. This pilot may complain that the air traffic controllers should be doing a better job. The confidence that this pilot displays is not consistent with the pilot's experience and/or abilities when measured objectively. The AGGRESSIVE / FORCEFUL pilot will answer a question, even it not sure of the correct answer, with the belief that he or she is simply to be recognized as an expert. This pilot usually has an inflated opinion of his or her abilities.

TIMID

At the other extreme, the TIMID pilot appears to not only consider others but will delay actions with the expectation that another person may provide guidance. The delay in acting or responding without guidance may be sufficiently long such that only one response or action remains to accomplish a goal. This pilot, while capable of analysis, cannot act appropriately and appears to be constantly hesitating and delaying.

The TIMID pilot will be relieved to hear a weather briefer state that VFR flight is not recommended, even though the data clearly indicates such a situation. This pilot will not simply ask others for information but may also request conclusions upon which this pilot will act.

In the aircraft the TIMID pilot will seem unsure of procedures even though a checklist is being used. Taxiing away from parking will seem to be a painful process in that this pilot does not seem sure of the next required move. This pilot will have been cleared to cross a runway intersection, will have acknowledged that clearance and remembers it, will stop prior to crossing the intersection, look for traffic, see none, wait for what seem to be an unreasonably long time and then again request clearance to cross the intersection.

The pilot will not only not jockey for position at the active runway, but will let anybody else pass by simply because of an inability to decide on when to proceed.

During flight the TIMID pilot will appear unreasonable cautious. The ability to execute a given task, for example, is unjustifiably delayed because this pilot seems unable to decide when he or she has made enough clearing turns. The pilot is able to discuss the elements involved in an engine failure situation while en route, but is frozen in action during practice simply because of an inability to determine that a previous action is adequately accomplished and that the time has come to proceed to the next action.

Typically, when unsure of what to do during a flight test, this pilot will ask the pilot examiner what course of action to take. Appropriately, the pilot examiner will find him or herself directing this applicant to act as they think best and not to ask such questions.

During tasks that require a high degree of skill, this pilot will indeed execute the task, but fail to critique performance during the operation. For example, the TIMID pilot will seem to take a deep breath before performing a soft field takeoff and then ask the pilot examiner how it went after completion. This pilot will find it difficult to determine a means to enter the traffic pattern at a busy uncontrolled airport.

DISCUSSION

Clearly, a pilot examiner must observe a balance between these two extremes. Any given task may appropriately demand either extreme. However, a pilot examiner must decide if such is the case. Overall, though, should a majority of tasks be evaluated by the pilot examiner as being beyond (3) on either end of the range, the applicant should be considered to have failed to behave appropriately on this particular range of required behavior. Generally, this failure will also be accompanied by a failure of the required task, such as the AGGRESSIVE / FORCEFUL applicant's failure to obtain a complete weather briefing and subsequently encountering IFR in violation of regulations.

It is possible that a pilot applicant may, then, fail psychologically on any one task. It is more likely, however, that the pilot examiner will face a situation in which a hazardous thought pattern is recognized, but the task is completed satisfactorily. In such cases the pilot examiner is expected to continue testing to determine if this, or any other exercise of a hazardous thought pattern constitutes a failure item. This continued testing is common practice today as it applies to pilot motor skills.

ANTI-AUTHORITY HAZARDOUS THOUGHT PATTERN

DEFIANT--CONFORMIST

5 4 3 2 1 0 1 2 3 4 5

During the evaluation of tasks observed by the pilot examiner, a balance between the two extremes shown above must be displayed by the pilot applicant.

DEFINITIONS

DEFIANT is defined as behavior displaying a lack of regard for standard policies, procedures, or regulations.

CONFORMIST is defined as behavior characterized by total, unquestioned, and absolute compliance with policies, procedures, or regulations.

DEFIANT

The DEFIANT pilot exhibits all the tendencies of one who believes that policies, procedures or regulations apply to others and not him or herself. Rules are made to be broken, or at the very least, cannot possibly apply to any and all situations. This pilot believes that standardization causes more accidents than it prevents. He or she has as many excuses for not complying with policies, procedures or regulations as there are situations in which they should be applied. This defiance is more cause than belligerent. It is simply a disregard for what is known. Lack of knowledge does not characterize the DEFIANT pilot.

In practice the DEFIANT pilot will not use a checklist for any number of reasons, may or may not listen to the Automatic Terminal Information Service (ATIS), may taxi at any desired speed and fail to use proper radio phraseology. This pilot will operate in compliance with regulations only when convenient, and so, will not hesitate to fly low after first determining that it is safe to do so. Overall, this may not be an unsafe pilot necessarily; but safety, as defined by others, is not an important consideration.

CONFORMIST

The CONFORMIST pilot is lost without checklists, manuals, regulations, procedures, and policies. If the CONFORMIST does not have, or has not received guidance, he or she will probably not be able to execute a task or make a decision. This pilot operates as does blind justice.

This pilot will use a checklist but, perhaps, will miss the item that calls for applying wheel brakes prior to engine start. As a result, an observer will see the airplane move upon engine start. There is not guarantee that wheel brakes will ever again be applied if missed on the checklist.

If, while taxiing, radio communications with the control tower are lost and no other signal is received, this pilot will most likely respond inappropriately, if at all, or respond appropriately by chance. The CONFORMIST can be a reliable pilot much of the time. However, when creativity is called for all may be lost. This pilot may follow directions to destruction. The pilot is not one to give up or relinquish responsibility: this pilot is simply compelled to follow authority.

DISCUSSION

In evaluating the ANTIAUTHORITY HAZARDOUS THOUGHT PATTERN the pilot examiner must distinguish between the pilot who is DEFIANT and one who has no knowledge. If there is no knowledge, a pilot cannot be DEFIANT. This is not the case with the CONFORMIST, since the CONFORMIST will only be able to act appropriately as a result of having knowledge. In other words, the DEFIANT pilot may carry on quite well while willfully violating policies, procedures, and regulations; the CONFORMIST cannot effectively operate beyond those bounds. The CONFORMIST knows when he or she knows, and that is all.

The evaluation of this hazardous thought pattern is very limited in scope since it deals only with knowledge and application of policies and procedures and regulations, and not skill or ability as such.

RESIGNATION HAZARDOUS THOUGHT PATTERN

INSISTENT--YIELDING

5	4	3	2	1	0	1	2	3	4	5

During the evaluation of tasks observed by the pilot examiner, a balance between the two extremes shown above must be displayed by the pilot applicant.

DEFINITIONS

INSISTENT is defined as behavior characterized by determined, unrelenting attempts to gain the accomplishment of an objective in the face of known or familiar hazards or obstacles.

YIELDING is defined as behavior displaying relinquishment or assignment of responsibility, control, or authority to an outside influence.

INSISTENT

The INSISTENT pilot will try and try again. This pilot recognizes the obstacles to desired performance but will fail to admit that his or her ability will not overcome them. The pilot believes that success rests only with personal ability and that any hazards impeding accomplishment must be, and will be overcome. This pilot does recognize such influences as fatigue, diet, weather, and aircraft performance, but believes that each can be under his or her direct control. The INSISTENT pilot is different from the AGGRESSIVE / FORCEFUL pilot in that he or she is not bold, belligerent, or self congratulating: the INSISTENT pilot is quite accurately aware of his or her own level of competence and yet believes that they will be sufficient in all instances as long as attempts at success continue.

The INSISTENT pilot is one who will continue to attempt to start an airplane engine until the battery dies. He or she will also insist on being able to taxi an airplane during strong crosswind conditions with one wheel brake inoperative. This pilot will continue attempting a crosswind landing beyond personal ability until an accident results. The INSISTENT pilot will attempt a shore field takeoff when the aircraft handbook indicates that such an attempt will fail, continue to destination in poor weather and generally attempt anything with a "do or die" attitude.

Again, it's not that this pilot is unaware of hazards: simply, it is believed that persistence will triumph.

YIE, DING

The YIELDING pilot generally operates on the belief that anybody else who seems to be knowledgeable, probably has better ideas, skills, aptitude, or at least more confidence. This belief makes this otherwise knowledgeable and skillful pilot a mass of self-doubt when others offer advice or instructions. This offering usually results in he following of other's advice or instructions even if suspected to be in error or inappropriate. This leads to confusion, time delays, or both, and usually results in an accident. After the accident the YIELDING pilot states that it was known that what he or she was doing, on the advice of others was probably not right.

The YIELDING pilot differs from the CONFORMIST in that the YIELDING pilot knows what should probably be done, yet believes others are more capable. Also, this pilot may not ac-

cept responsibility for poor performance, but rather, assign blame to some outside source. This pilot may be heard to say such things as, "if only (it, she, he, they, that...etc)".

The YIELDING pilot may allow an air traffic controller to turn the airplane into obstacles, may allow UNICOM to suggest landing on a downwind runway, may allow a passenger to make operational type decisions, even though the passenger may not know he or she is actually doing so, and may be susceptible to peer pressure. In other works, the YIELDING pilot has a tendency to allow others to make decisions and suggest actions. This pilot has no problem assuming control and pilot in command duties otherwise. This pilot does not necessarily seek advise, but will usually assign blame.

IMPULSIVITY HAZARDOUS THOUGHT PATTERN

SPONTANEOUS--PONDERING
5 4 3 2 1 0 1 2 3 4 5

During the evaluation of tasks observed by the pilot examiner, a balance between the two extremes shown above must be displayed by the pilot applicant.

DEFINITIONS

SPONTANEOUS is defined as behavior characterized by action without sufficient thought.

PONDERING is defined as behavior characterized by delayed action that is, therefore, inappropriate due to lengthy thought processes.

SPONTANEOUS

The SPONTANEOUS pilot acts on the first or first few thoughts that come to mind. Inappropriate responses will not only be witnessed during emergency procedures, but also during planning activity. Generally, action may be seen to satisfy an emotional need, as in the need to hurry to accommodate passengers to the sacrifice of safety. In short, when an action is inappropriate it is simply the result of not engaging in sufficient thought.

Also, as a result of being spontaneous, things seem to "pass by" this pilot unnoticed. When asked later if this pilot saw, heard, felt, or was otherwise aware of something, the general answer would be "no". This is because this pilot does not give sufficient thought or mental awareness to the environment. As such, the SPONTANEOUS pilot may make few appropriate decisions.

PONDERING

The actions of the PONDERING pilot are inappropriate because they are engaged after the need for them is over. The PONDERING pilot does not arrive at timely decisions simply because his or her thought process is slower than the time required in which to arrive at a decision and act on it. For example, this pilot will stop prior to taxiing across a runway at an uncontrolled airport and see traffic on final approach. The pilot will begin to decide whether or not to cross the runway. As time goes by the pilot becomes stressed and has further difficulty arriving at a decision. Finally, the decision is made to cross the runway just as the traffic on final approach crosses over the runway quickly and the landing traffic has to abort to avoid collision.

While the PONDERING pilot will not have difficulty during the planning stages of flight, he or she will begin to suffer in the aircraft. Whenever time is a consideration, this pilot will experience difficulty. If lost on a cross country, the pilot may exhaust fuel supplies before deciding on a course of action. If in an emergency situation, the pilot may appear to be doing many things at once without accomplishing anything. The PONDERING pilot differs from the CONFORMIST in that the CONFORMIST may not know what to do, and so, does nothing, while the PONDERING pilot simply has difficulty arriving at a decision while time remains to do so.

In short, this pilot simply thinks too slowly.

DISCUSSION

Both the SPONTANEOUS and PONDERING pilot have trouble, not with the content of decisions, but with the fact that in one case there is not enough of the process, and in the other there is too much. The SPONTANEOUS pilot is a hazard both in the planning stage and flight stage. The PONDERING pilot is a hazard in the flight stage only, provided he or she decides to get that far.

INVULNERABILITY HAZARDOUS THOUGHT PATTERN

CAREFREE ---TREPID
5 4 3 2 1 0 1 2 3 4 5

During the evaluation of tasks observed by the pilot examiner, a balance between the two extremes shown above must be displayed by the pilot applicant.

DEFINITIONS

CAREFREE is defined as behavior characterized by a disregard for hazards and dangers because they are not perceived as such.

TREPID is defined as behavior characterized by an unrealistically high regard for hazards and dangers so as to render the pilot incapable of action.

CAREFREE

The CAREFREE pilot considers him or herself incapable of coming to grief in an airplane. This consideration is especially false since the pilot generally is quite aware of personal, environmental, and aircraft limitations when pressed for that awareness. Usually this pilot would rather not think of accidents, but rather, concentrate on the brighter side of flying. As a result of that kind of thinking, it would not be constructive to this pilot's sense of well-being to consider hazards and dangers. Therefore, since hazards and danger are not a part of reality for this pilot, he or she flies as if they do not exist.

This is not to say that the CAREFREE pilot is not capable of acting during an emergency, but here again, the particular emergency is not fully understood for its life threatening potential. The pilot will not act appropriately simply because others may perceive a life or death situation. Appropriate action, if taken, is taken for its own sake. Observers are led to conclude that this type of pilot is plain lucky and quite skillful besides.

The CAREFREE pilot will not take appropriate precautions during preflight planning or flight. This pilot may depart from a runway with little thought of looking for conflicting traffic. He or she will begin flight maneuvers without performing clearing turns. A preflight inspection is not seen as very important. Cross country planning may consist of little more than running a string along a wall chart. All this is taken lightly because hazards and dangers are not considered real.

TREPID

For any of a number of reasons the TREPID pilot is so aware of hazards and dangers that he or she becomes overcautious. Looking for traffic while airborne becomes so engrossing that a communication with air traffic control may be missed. Concentration on not becoming lost during a cross country trip becomes so consuming that fuel management is neglected. Or perhaps concentration on any other two important items causes a neglect of the third and fourth. In other words, the TREPID pilot is so consumed with fear and danger, he or she fails to place any one of them in perspective and deal appropriately with hazards and dangers in the general way pilots must. Priorities are difficult for this pilot since everything is dangerous.

DISCUSSION

The pilot examiner may find it difficult to evaluate this range. Indeed, some emergencies, for example, require a pilot to deal with one item to the exclusion of others in order to arrive at a successful conclusion. On the other hand, that which constitutes a danger or hazard for one pilot of a given level of experience and skill may not for another. A pilot examiner must rely on his or her own experience and education to determine if an applicant is dealing appropriately with hazards and dangers. Respect and knowledge of hazards and dangers by pilot applicants is healthy.

SUMMARY

At the stage of thought that this paper is written, it is intended that pilot examiners grade each task that a pilot applicant performs along the five ranges of hazardous thought patterns. It is envisioned that the examiner have cards as shown below with which to accomplish this. The pilot examiner may or may not document each acceptable performance.

Each unsatisfactory grade, characterized by a (4) or greater score, would require that the examiner show how the hazardous thought pattern resulted in a performance that is unsatisfactory according to the practical test standards. For example, a pilot applicant may be AGGRESSIVE / FORCEFUL during a preflight weather briefing and not allow important information to be said by the briefer. This culminates in the conduct of a flight during which the pilot applicant enters IFR and the examiner takes control of the aircraft. In such a case the card would be marked as shown.

It is also possible that the exercises of a hazardous thought range may result in an unsatisfactory determination by a pilot examiner even though performance, according to the practical test standard, would not so indicate. An example may be that of an applicant allowing his or her aircraft to be positioned beyond power off gliding distance from a shoreline. This would be poor judgment, not necessarily a violation of regulation or an operation contrary to a test standard.

It is believed that in each case a (4) or greater score would need to be backed up by observable, unsatisfactory behavior or operation for it to be considered unsatisfactory in itself. It is assumed during such grading that the pilot examiner will accurately evaluate the applicant's level of competence so that an acceptable determination of judgment applications, or misapplications may be made.

This is by no means a complete suggestion. It is simply an outline that may stimulate further consideration.

APPENDIX B

RISK EVALUATION

AND

AVIATION RESOURCE MANAGEMENT

by

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REARM

RISK EVALUATION AND AVIATION RESOURCE MANAGEMENT

The process described below is adapted from the article in the September issue of "*Army Aviation Digest*" and a subsequent adaptation of that original article by Commander Dennis Mclean, United States Coast Guard Flight Safety Center.

While both of these Services have divergent aviation mission requirements the process of "risk assessment" that is described is easily adapted to any aviation activity that involves high mission risk factors. While both articles stress the need for Aviation Command intervention as an essential ingredient in managing risks associated with particular mission assignments or requirements, the assessment tool itself is particularly valuable to EMS helicopter operations.

The EMS helicopter is a relatively new approach to prehospital practice requiring multiple applications of familiar skills in a unique and frequently difficult environment. For the first time, health care and non-health care personnel must function as co-equals in order to fulfill their missions. This co-equality, and the necessary adjustments it provokes, introduce numerous special factors that impact this working environment.

The current unacceptable high accident rate within the EMS helicopter industry has demonstrated the need for both education and **involvement** of all levels of management. "Risk Management" is a joint process that requires a concentrated effort between the suppliers, users, and operators of EMS aircraft.

Essentially, the Risk Management approach is the identification of risks associated with a particular operation and the requirement to weigh these risks against overall objective or value to be gained. Safety is a by-product of risk reduction and management of inherent mission risks. In this manner, safety and mission will never conflict; rather, they blend together to produce optimum results.

At present, the EMS helicopter community has no adequate means of measuring the risks involved in EMS operations. The current process, for the most part, is a subjective assessment of hazards by the duty pilot at the moment a mission request is received. Many in this profession quietly harbor the belief that accidents are the unavoidable cost of doing business in an intrinsically dangerous profession and that the overall benefit to mankind outweighs those associated risks.

What is needed is a quick test, a litmus test, to measure the risks associated with an ever increasing spectrum of EMS and EMS related helicopter missions. Vendors, Program Managers/Directors, Chief pilots, Lead pilots, and Line pilots need a tool to measure risk. The Risk Evaluation and Aviation Resource Management (REARM) test is designed to evaluate the probability and magnitude of adverse effect. Six elements (supervision, planning, crew selection, crew endurance, weather, and mission complexity) are central to safe completion of any aviation operation. Developing a graduated risk matrix for each of the six elements would allow a numerical assessment to assignment of risk.

Supervision. The level of supervision is assessed by comparing mission type to managerial control. A pre-planned site visit, a hospital to hospital transfer, and a scene flight are viewed as graduated mission types. Managerial control ranges for total aviation supervision by the Aviation Manager (Vender, Operations Manager, Chief/Lead Pilot) to aviation assets being placed under the control of non-aviation intermediaries (Program Director, Chief Flight Nurse, Medical Director, and untrained scene personnel). For this test the three levels are defined as **Aviation** (Vendor, Operations Manager, Chief/Lead Pilot), **Independent operations** (duty pilot), and **Non-aviation control** (Program Director, Chief Flight Nurse, Medical Director, and untrained scene personnel).

Supervision Factor
Risk Value

Aviation Managerial Control	Mission		
	Site Visit	Hospital	Scene
Non-Aviation	3	4	5
Independent	2	3	4
Aviation	1	2	3

Example: A helicopter deployed to an accident scene without trained personnel to establish the LZ would receive a risk assessment factor of 5.

Planning. The planning element is assessed by comparing guidance to preparation. Precise guidance and an extended time for preparation are seen as optimal.

(continued on page 2)

REARM

(continued from page 1)

Planning Factor
Risk Value

Guidance	Preparation		
	In-Depth	Adequate	Minimal
Vague	3	4	5
Implied	2	3	4
Specific	1	2	3

Example: An immediate launch to an uncontrolled accident scene with instructions to select your own landing zone, so that guidance is implied but preparation is minimal, would'receive risk assessment factor of 4.

Crew Selection. Crew selection is assessed by comparing aircraft mission with total crew experience. New statistical surveys are beginning to show a direct correlation to high incident rate and limited EMS pilot mission exposure. Total crew experience also has a correlate to the amount and quality of medical crew aviation oriented training. Unlike the Army or Coast Guard model, EMS Pilot experience levels are pre-determined by professional EMS organizations and as a general rule require high flight time experience as a prerequisite to hiring. Unfortunately, many organizations do not have realistic training programs that address the EMS mission. Consequently, the measurable factor remains as total EMS experience.

Crew Selection Factor
Risk Value

Aircraft Mission	Total Crew Experience		
	1-5 Years	6-12 Mos.	1-6 Mos.
Scene	3	4	5
Hospital	2	3	4
Site	1	2	3

Example: A scene mission with an EMS pilot with 1-5 years EMS experience would have risk assessment value of 3.

Crew Endurance. Crew endurance is assessed by comparing the quality of rest to the length of rest. Shift schedules that reduce the interruptions of normal body circadian rhythms, provide for well thought out approaches to shift phase advances and delays along with a crew quarters that realistically provide for uninterrupted sleep and that address quality of life issues are considered optimal. Time of launch is as important in determining the quality of rest as the total time. A 0200 launch interrupts the sleep pattern and degrades rest. There is sufficient literature available in regards to the deleterious effects of EMS pilot scheduling and staffing. Managers at all levels need to become more aware of the hazardous consequences of ignoring quality of life issues for EMS pilots. Unlike the Army and Coast Guard, EMS operations involve a single pilot, at the controls, effectively eliminating the safety valve of having two or more qualified pilots concentrating on pure aviation matters.

Weather. Weather is assessed by comparing wind velocity with ceiling and visibility. Minimums are defined as the lowest ceiling and visibility allowed by appropriate directive for the mission. Night time is added as a multiple factor. Multiply the value by 1.5 for night missions. Note that very light winds are considered a higher risk than winds of 10 knots. This is predicated on the beneficial effects that are gained from the winds when taking off and landing high gross weight EMS helicopters.

Weather Factor
Risk Value

Wind Velocity (Knots)	Ceiling/Visibility		
	Clear	VFR (1000/3)	Minimums
30*	3	4	5
20	2	3	4
10	1	2	3

Notes:
*For winds in excess of 30 knots, add 1 to the risk value for each ten knots of additional wind.
Multiply the value from the chart by 1.5 for night missions.

Example. Weather if VFR (1500 scattered/visibility 5 miles), wind 30 knots, at night. The risk assessment value would be 4 x 1.5 (night multiple) = 6.

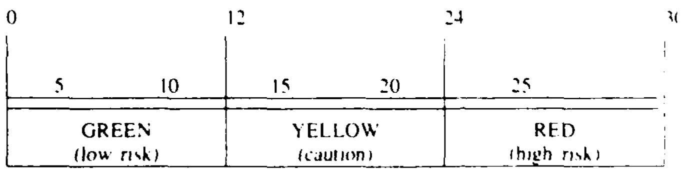
Complexity. Complexity is assessed by considering total flight time, operational environment, and landing area. A total flight time of four hours would require multiple landing, refuelings, and aircraft re-stocking. The choice of landing area/ operational environment would be the most hazardous encountered.

Mission Complexity Factor
Risk Value

Flight Time	Landing Area/Operational Environment		
	Improved	Helopad	Unknown
4 Hours	3	4	5
2 Hours	2	3	4
1 Hour	1	2	3

After all risks have been assessed, the values would be totaled and applied to the quick reference test chart. The total risk assessment value is rounded up to the next whole integer.

Risk Evaluation Value Scale



Operations with a value of 0 to 12 are judged as low risk. A value of 13 to 23 is seen as a caution area; complete aviation management assessment is warranted. High risk operations require coordination, prior to flying the mission, with the next higher level of aviation management, external to the program

(continued)

REARM

(continued from page 2)

making the assessment. Any aviation management or flight qualified person detecting an unsafe act or condition is authorized to abort the mission.

To demonstrate the use of REARM, two scenarios involving typical EMS helicopter missions are addressed. The first is a hospital to hospital patient transfer and the second is a scene pickup.

Scenario 1. Hospital Transfer.

Element	Risk Value	Assessment Elements
Supervision	2	Mission is hospital transfer to pre-approved and surveyed area. (Aviation)
Planning	2	Guidance is specific; adequate time is available for preparation.
Crew Selection	3	Hospital transfer with pilot possessing eight months EMS experience.
Crew Endurance	2	Hospital transfer with pilot having come in that morning from home.
Weather	2	Forecast VFR, with 10 knots for the entire mission.
Complexity	1	Mission will originate and terminate at hospital helipads, mission length 40 minutes.
Alert Value =	12	Low risk mission.

Scenario 2. Scene: patient pickup, daylight.

Element	Risk Value	Assessment Elements
Supervision	5	Scene pickup with non aviation trained landing zone personnel at the accident site. Program Director on duty and has expressed concern over low monthly utilization rate. Pilot and crew feel pressure to respond.
Planning	4	Scene planning is implied by our profession, time is minimal.
Crew Selection	4	Scene response. Pilot has 10 months EMS experience.
Crew Endurance	4	Scene mission with adequate rest prior to flight.
Weather	3	Forecast VFR, winds 20 knots on scene.
Complexity	5	Operational environment uncontrolled, pilot cannot rely on ground personnel to control crowd or provide security. Mission time less than 20 minutes.
Alert Value	25	High risk Mission.

Statistical data is currently indicating that nearly all EMS helicopter operations fall into the high risk area of flight operations. The above matrix is a safety tool that can be used to measure the amount of risk associated with particular EMS operations. Today's challenge is to find tools that help identify risks that are associated with this industry and to reduce those risks through modern and innovated techniques of risk management. Preventable risk is risk that can be reduced or eliminated by establishing operational parameters within constraints of existing resources and technology without unacceptable impediment of the mission.

The risk management process involves the following:

1. Risk identification.
2. Risk evaluation and qualification.
3. Risk reduction.
4. Risk decisionmaking.
5. Risk decision followup.
6. Risk research.

EMS Program Administrators/Directors, Line pilots, Chief pilots, Lead Pilots, Medical Directors, and Crew members must all become involved in the process of risk management.

Richard J. Fedorowicz
Lead Pilot/Base Manager
Nightingale

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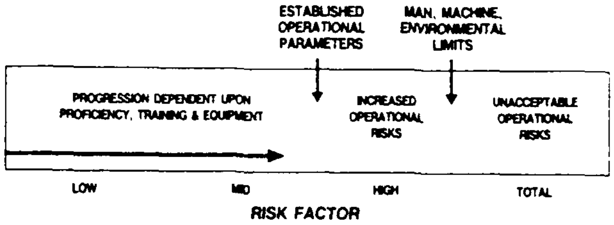
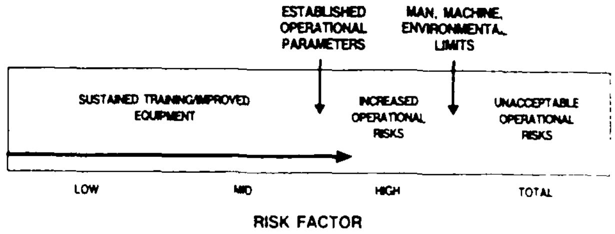
HELICOPTER EMS OPERATIONS RISK MANAGEMENT PLAN





HELICOPTER EMS OPERATIONS OVERALL OBJECTIVES